Avian Surveys and Parasitism Control and Evaluation on Clark County Multiple Species Habitat Conservation Plan Properties 2023 Final Project Report

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PREPARED FOR

Desert Conservation Program

Clark County Department of Environment and Sustainability

PREPARED BY

SWCA Environmental Consultants

AVIAN SURVEYS AND PARASISTISM CONTROL AND EVALUATION ON CLARK COUNTY MULTIPLE SPECIES HABITAT CONSERVATION PLAN PROPERTIES 2023 FINAL PROJECT REPORT

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EXECUTIVE SUMMARY

In 2023, SWCA Environmental Consultants (SWCA) conducted avian surveys across all properties managed by the Clark County Desert Conservation Program (County); these properties include the Riparian Reserve Units and the Boulder City Conservation Easement (BCCE). Surveys were conducted to build on the baseline dataset of avian species presence and distribution at the County's properties. These baseline data can be compared with future data to quantify the success of management and restoration efforts at the County's properties. Surveys consisted of three rounds of breeding bird point-count surveys at the Riparian Reserve Units and at the BCCE and species-specific surveys for southwestern willow flycatcher (*Empidonax traillii extimus*) and yellow-billed cuckoo (*Coccyzus americanus*) at the Riparian Reserve Units. SWCA also continued intensive southwestern willow flycatcher monitoring at Mesquite West (a historic southwestern willow flycatcher breeding site that includes County Parcel 1-A) and Mormon Mesa Parcel 5-A and brown-headed cowbird (*Molothrus ater*) control at Mesquite West in 2023. In addition, SWCA conducted a thermal refugia study across the County's Riparian Reserve Units.

Surveys conducted in 2023 were completed between May 1 and August 8. During point-count surveys, surveyors detected six of the eight bird species covered by the Clark County Multiple Species Habitat Conservation Plan (MSHCP): American peregrine falcon (*Falco peregrinus anatum*), Arizona Bell's vireo (*Vireo bellii arizonae*), blue grosbeak (*Passerina caerulea*), phainopepla (*Phainopepla nitens*), southwestern willow flycatcher, and yellow-billed cuckoo. In addition, two of the other bird species covered by the MSHCP were detected incidentally: a single summer tanager (*Piranga rubra*) was detected during a southwestern willow flycatcher survey, and two vermilion flycatchers (*Pyrocephalus obscurus*) were detected during yellow-billed cuckoo surveys. The surveys also yielded three evaluation species: loggerhead shrike (*Lanius ludovicianus*), crissal thrasher (*Toxostoma crissale*), and LeConte's thrasher (*Toxostoma lecontei*). In total, 81 avian species were recorded across all the County's properties in 2023, and MSHCP-covered and evaluation species were observed at each property.

Southwestern willow flycatcher monitoring was conducted between May 15 and August 16, 2023, to determine residency of willow flycatchers (*E. traillii*), find and monitor southwestern willow flycatcher nests, and band adult and nestling southwestern willow flycatchers. The monitoring program was also important in assessing the effects of brown-headed cowbird control on southwestern willow flycatcher nest success at Mesquite West. In total, 29 adult willow flycatchers were detected at Mesquite West and Mormon Mesa Parcel 5-A. The 29 individuals comprised nine pairs, five unpaired males, and six individuals for which residency or breeding status, or both, could not be determined. Thirteen confirmed nesting attempts were documented; six of these attempts were successful. Six adult and 13 nestling southwestern willow flycatchers were newly banded in 2023; one adult banded in a previous year was recaptured. Of the 13 nestlings banded at Mesquite West, 11 were confirmed to have fledged.

SWCA conducted brown-headed cowbird control at Mesquite West from May 9 through July 26, 2023. SWCA biologists performed targeted mist-netting of adult and fledgling brown-headed cowbirds over 15 mornings, totaling 26.3 net-hours. Male brown-headed cowbirds were released, and females were euthanized. In total, 10 adult brown-headed cowbirds (0.4 adults/net-hour) were captured, of which six were male. Four brown-headed cowbird females were euthanized. One brown-headed cowbird egg in a southwestern willow flycatcher nest was replaced with a fake egg in 2023.

Deployment of Maxim Integrated Products, Inc. DS1923 iButton temperature/humidity loggers across the County's Riparian Reserve Units began in late May and continued through July 26. Ten dataloggers were installed near southwestern willow flycatcher nest locations at Mesquite West and Mormon Mesa Parcel 5-A. An additional 10 dataloggers were installed in unoccupied southwestern willow flycatcher habitat. Twenty-two dataloggers were installed in riparian habitats that did not resemble southwestern willow flycatcher breeding habitat but where other MSHCP-listed species were recorded during at least one of

the first two rounds of point-count surveys or incidentally while conducting other work at the County's Riparian Reserve Units. Dataloggers were programmed to collect 8-bit temperature and relative humidity readings every 30 minutes and were deployed until August 15. Two dataloggers deployed in unoccupied southwestern willow flycatcher habitat in Bunkerville Parcel 2-M yielded microclimate data most similar to that recorded at southwestern willow flycatcher nests.

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1 INTRODUCTION

The Clark County Desert Conservation Program (County) manages compliance with the Endangered Species Act (ESA) through the Clark County Multiple Species Habitat Conservation Plan (MSHCP) (Clark County Department of Comprehensive Planning (CCDCP) and U.S. Fish and Wildlife Service [USFWS] 2000). This is accomplished, in part, through the management of a reserve system, which includes Riparian Reserve Units and the Boulder City Conservation Easement (BCCE). The MSHCP covers eight bird species, six of which are known to occur primarily in desert riparian habitats: Arizona Bell's vireo (*Vireo bellii arizonae*), blue grosbeak (*Passerina caerulea*), southwestern willow flycatcher (*Empidonax traillii extimus*), summer tanager (*Piranga rubra*), vermilion flycatcher (*Pyrocephalus rubinus*), and yellow-billed cuckoo (*Coccyzus americanus*). The other two MSHCP-covered bird species can occur either in or away from desert riparian habitats: phainopepla (*Phainopepla nitens*) is typically found in desert washes with mesquite (*Prosopis* spp.) or catclaw acacia (*Senegalia greggii*), and American peregrine falcon (*Falco peregrinus anatum*) can be found in almost any type of habitat but prefers to nest on cliff faces (CCDCP and USFWS 2000). Two of the eight covered bird species are also federally protected under the ESA—southwestern willow flycatcher, listed as endangered (USFWS 1995), and yellow-billed cuckoo, listed as threatened (USFWS 2014). In addition to the eight covered species, several evaluation species can be found in a variety of desert habitats, including upland habitats, which compose most of the BCCE.

The extent and quality of native desert habitat across the Southwest, particularly desert riparian habitat, have been steadily diminishing for decades, threatened by urban and agricultural development, invasion of non-native species such as tamarisk (*Tamarix* spp.), fire, and the reduction of water tables through unsustainable water use (Clark County 2015). Because quality avian habitats, particularly riparian habitat, are scarce within arid environments, management of these areas, and conservation of the MSHCP-covered avian species that inhabit them, are essential to these species' survival.

1.1 Description of the Project

In 2019, the County solicited proposals to conduct continued avian surveys on its Riparian Reserve Units (Figure 1) and on the BCCE (Figure 2). The County contracted SWCA Environmental Consultants (SWCA) to conduct presence/absence surveys for both southwestern willow flycatcher and yellow-billed cuckoo across its Riparian Reserve Units (Muddy River, Virgin River Subunit 1 [Mesquite], Virgin River Subunit 2 [Bunkerville], Virgin River Subunit 3 [Riverside], and Virgin River Subunit 5 [Mormon Mesa]) (see Figure 1), as well as to conduct avian point counts at predetermined locations across the Riparian Reserve Units and the BCCE. In 2020 and 2021, SWCA continued these surveys at all the properties surveyed in 2019 and at an additional property that the County purchased in early 2020 (Bunkerville Parcels 2-K, 2-L, and 2-M). In 2022, surveys were added at another property that the County purchased in late 2021 within Virgin River Subunit 6 (Mormon Mesa South) known as Parcels 6-A and 6-B. Surveys continued at all Riparian Reserve Units in 2023. Data collected for these surveys build on baseline presence/absence and relative abundance data for all bird species on these properties, including any MSHCP-covered and evaluation avian species. These data can be used to inform and evaluate the success of restoration efforts and land management decisions for these properties.

Starting in 2020, SWCA was also contracted by the County to perform southwestern willow flycatcher territory and nest monitoring at Mesquite West, a study site that includes Mesquite Parcel 1-A and adjacent habitat to the west (referred to as Mesquite West West). As part of this effort, brown-headed cowbird (*Molothrus ater*) control (not specifically covered in the 2020 contract) was limited to the addling of one brown-headed cowbird egg. All six southwestern willow flycatcher nesting attempts failed in 2020.

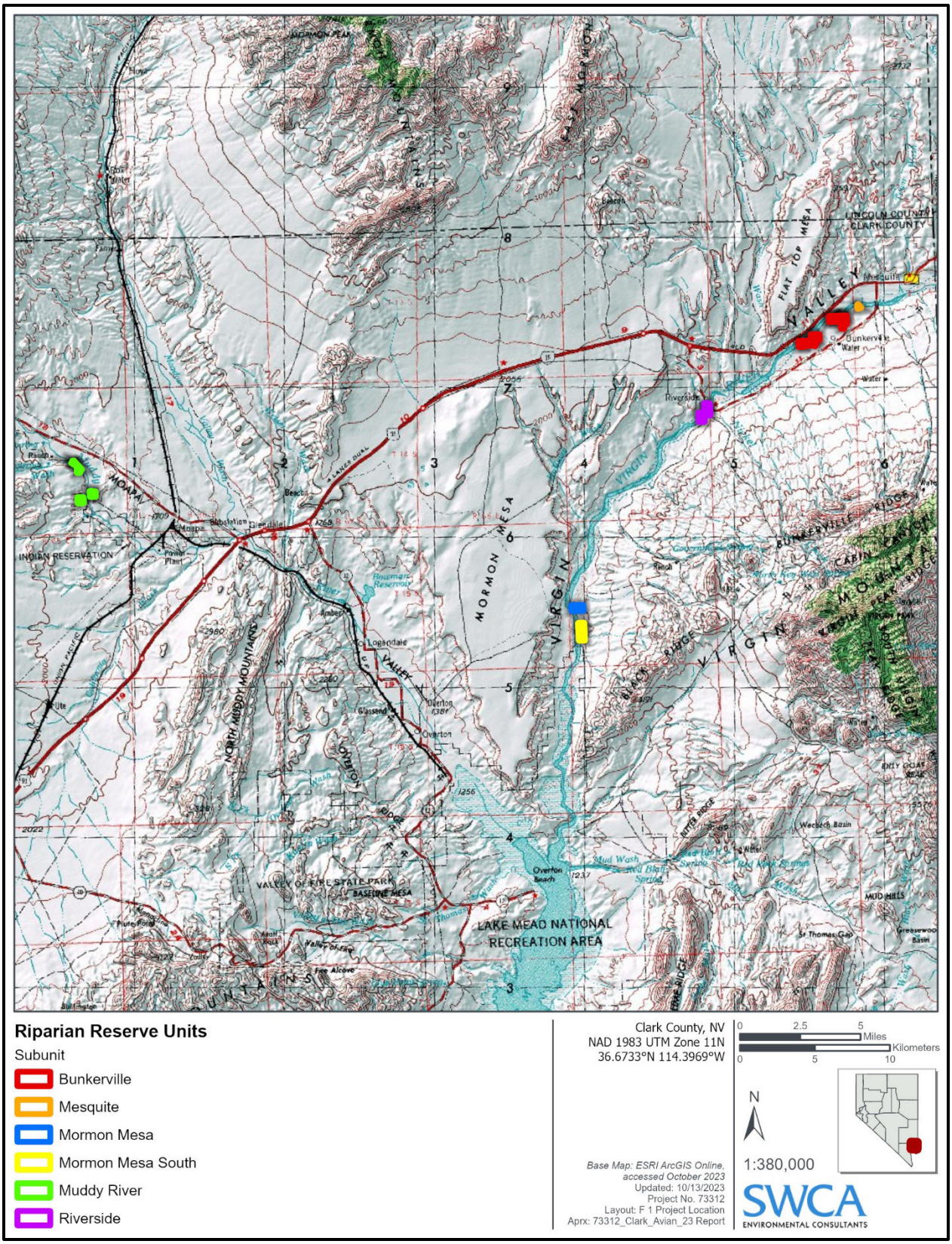

Figure 1. Riparian Reserve Unit locations.

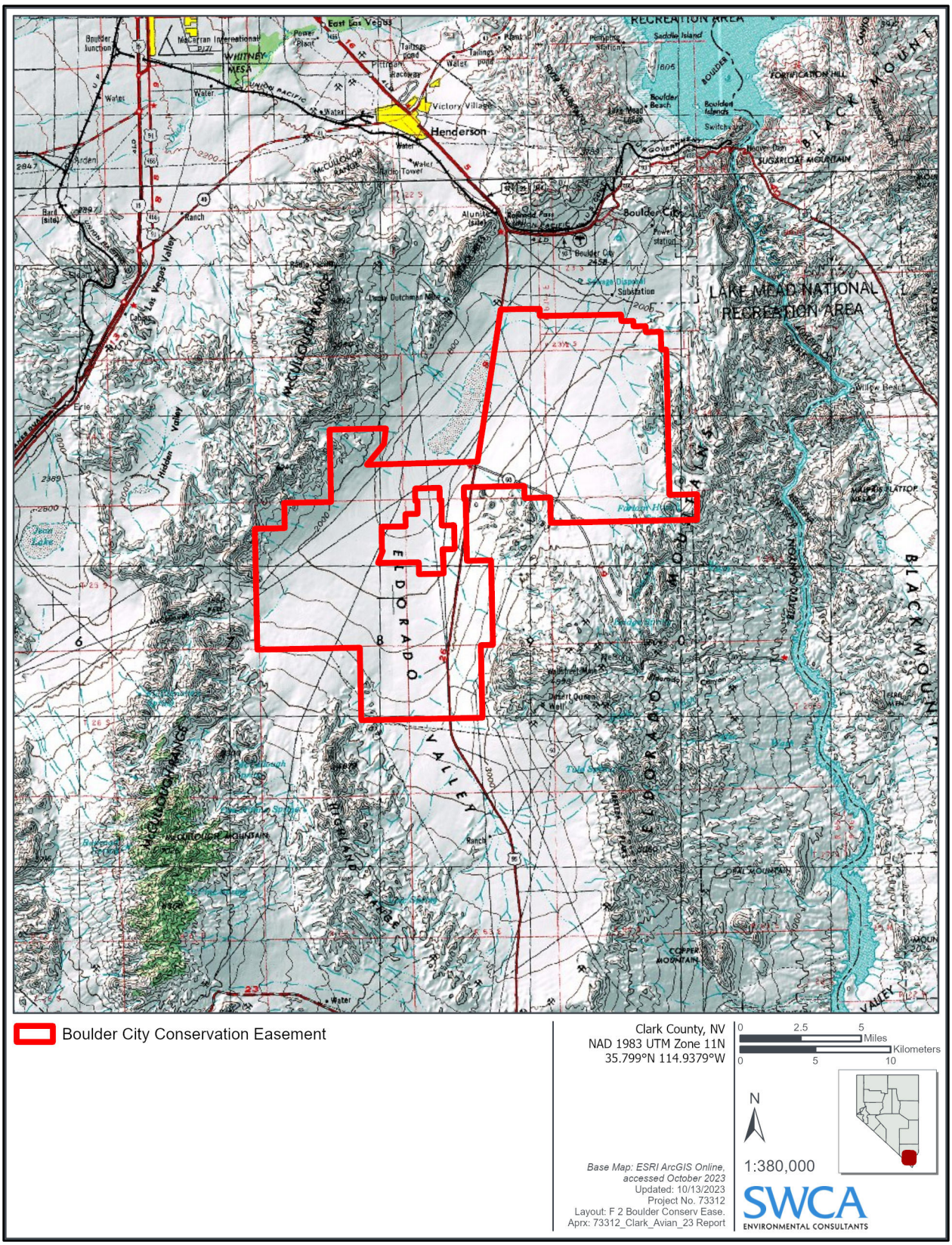

Figure 2. BCCE location.

In 2021, SWCA began implementing a target-netting program for brown-headed cowbird at Mesquite West to evaluate the potential of target netting in reducing the negative effects of brood parasitism (parasitism) on southwestern willow flycatcher nest success. This program was coupled with continued southwestern willow flycatcher territory and nest monitoring at Mesquite West. Additionally, in 2021, SWCA began southwestern willow flycatcher nest monitoring at Mormon Mesa Parcel 5-A. Territory and nest monitoring at Mesquite West and Mormon Mesa and brown-headed cowbird control at Mesquite West were continued in 2022, and SWCA's contract with the County for these activities was renewed in 2023.

The 2023 contract renewal included a one-season thermal refugia study, which consisted of a literature search and collecting temperature and humidity data across the Riparian Reserve Units. The goal of the literature search was to compile information about known thermal requirements for each MSHCP-covered riparian bird species. Goals of temperature data collection included identifying areas of potential thermal refugia for MSHCP-covered species, namely areas where the temperature seemed conducive for southwestern willow flycatcher nesting but did not otherwise meet the species' requirements for reproduction.

1.2 Background and Need

On November 19, 2000, the USFWS issued the Intra-Service Biological and Conference Opinion on Issuance of an Incidental Take Permit to Clark County, Nevada, for an MSHCP (Biological and Conference Opinion) (USFWS 2000). Then, on March 28, 2001, the USFWS issued an amended incidental take permit for the Clark County MSHCP (USFWS 2001).

1.2.1 Riparian Reserve Units

According to both the Biological and Conference Opinion and Condition K.1 of the associated incidental take permit, the County must acquire private property that contains desert riparian habitat along the Virgin River, Muddy River, and Meadow Valley Wash in Clark County. It was recognized that proper management of desert riparian habitats would be crucial in conserving the six bird species covered by the MSHCP (including the two federally listed species) that are known to use this habitat. To date, the County has acquired a total of 318 hectares (ha) (785 acres) of land along the Muddy and Virgin Rivers in northeastern Clark County, Nevada.

Prior to 2017, the County acquired 116 ha (286 acres) along the Muddy and Virgin Rivers. SWCA began conducting avian surveys at these parcels in 2017 to establish a baseline dataset of avian species presence and distribution under two separate projects: 1) Federally Listed Bird Surveys on Riparian Properties (SWCA 2017a) and 2) Point-count Surveys on Riparian Properties (SWCA 2017b). In late 2017, the County acquired an additional 130 ha (320 acres) along the Virgin River. Point-count surveys and species-specific surveys for federally listed species were conducted at these newly acquired properties under one project in 2018 (SWCA 2018a). In 2019, avian surveys at all the County's properties were combined into one project (SWCA 2019a). Point-count surveys and species-specific surveys for federally listed species were conducted at all the County's riparian properties through the 2021 field season, including at the newly acquired Parcels 2-K, 2-L, and 2-M (24 ha [59 acres]) (SWCA 2020, 2021). In late 2021, the County acquired an additional 48 ha (119 acres) along the Virgin River comprising Parcels 6-A and 6-B. Surveys were initiated at these parcels and continued at all other County properties in 2022 (SWCA 2022) and again in 2023; the 2023 survey efforts are described herein.

1.2.1.1 FEDERALLY LISTED BIRD SURVEYS

1.2.1.1.1 Species Background

Southwestern Willow Flycatcher

The southwestern willow flycatcher is one of four subspecies of willow flycatcher (*E. traillii*) (Unitt 1987). Throughout this report, the term "willow flycatcher" is used for individuals for which the subspecies could not be confirmed. The southwestern willow flycatcher breeds in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico and western Texas (Unitt 1987). Factors contributing to the decline of southwestern willow flycatcher on its breeding grounds include loss, degradation, and/or fragmentation of riparian habitat; invasion of riparian habitat by non-native plants; and parasitism by brown-headed cowbirds. One of the last long-distance neotropical migrants to arrive in North America in spring, southwestern willow flycatchers typically arrive in May or June and depart in August (Sogge et al. 2010).

Southwestern willow flycatchers nest in a variety of habitats, but common characteristics of southwestern willow flycatcher breeding habitat include dense tree or shrub cover ≥ 3 meters (m) (9.8 feet) in height, vegetation with dense twig structure and high canopy closure, and proximity to surface water or saturated soil (McLeod and Pellegrini 2013; Sogge et al. 2010). Southwestern willow flycatchers nest in habitat patches ranging in size from 0.8 ha (2.0 acres) to several hundred hectares but are rarely found in narrow strips of habitat less than 10 m (32.8 feet) wide (Sogge et al. 2010). During the nesting season, southwestern willow flycatchers occupy home ranges averaging less than 0.5 ha (1.2 acres) in size (Cardinal 2005). Willow flycatchers are generally monogamous, but polygyny has been documented (Ehrlich et al. 1988), particularly in the southwestern subspecies (SWCA 2019a, 2019b, 2020, 2021, 2022). Migrant willow flycatchers are found in both spring and fall in a variety of habitats that are unsuitable for breeding. These migration stopover habitats, though not necessarily used for breeding, are likely important for both reproduction and survival. Designated critical habitat for the southwestern willow flycatcher includes riparian habitats along the Virgin River from Berry Springs, Utah, downstream to the full pool level of Lake Mead (USFWS 2013a) and includes all five subunits of the Virgin River Riparian Reserve Unit.

Western Yellow-billed Cuckoo

The yellow-billed cuckoo was historically widespread and locally common along rivers throughout the western United States (USFWS 2013b). However, populations have declined across the West in recent years, largely as a result of loss, degradation, and fragmentation of riparian habitat. Consequently, the western distinct population segment was listed as threatened under the ESA in October 2014 (USFWS 2014). Critical habitat for the western yellow-billed cuckoo was designated in 2021, but no critical habitat units were designated within the state of Nevada (USFWS 2021).

Yellow-billed cuckoos are late neotropical migrants, arriving on their breeding grounds around mid-June and departing by mid-September. Yellow-billed cuckoo home ranges are generally at least 40 ha (100 acres) in size and often exceed 80 ha (200 acres), though home ranges as small as 1 ha (2.5 acres) have been documented (USFWS 2020). These patches are typically at least 100 m (328.1 feet) wide (USFWS 2020). Yellow-billed cuckoos have not been found nesting in isolated patches less than 1 ha (2.5 acres) in size or in linear habitats less than 10 to 20 m (32.8 to 65.6 feet) wide, but they may use these habitats during migration and early in the breeding season (Halterman et al. 2016). Breeding habitat is typically thought to include multi-storied riparian woodlands dominated by willow (*Salix* spp.) or cottonwood (*Populus* spp.) adjacent to watercourses with less than 3 percent slopes (USFWS 2020). In a

study at the South Fork Kern River Valley, CA, Wohner et al. (2020) found dense early successional riparian habitats 1 to 5 m (3.3 to 16.4 feet) in height to be especially important to yellow-billed cuckoos. A study of nest placement in Arizona and California found that nests were placed between 1 and 22 m (3.3 and 72.2 feet) above ground, with an average height of 7 m (23.0 feet) (Hughes 2020). Wohner et al. (2020) found nest height ranged from 2 to 4 m (6.6 to 13.1 feet) across two studies and averaged 4.8 m (15.7) at another study. Yellow-billed cuckoos tend to be serially monogamous, but serial polyandry has been regularly documented in western populations.

1.2.1.1.2 Survey Background

By 2019, the County had outlined 53.5 ha (132.2 acres) within the Riparian Reserve Units that were targeted for southwestern willow flycatcher and yellow-billed cuckoo surveys. Habitat suitability and the need for species-specific surveys were assessed during a site reconnaissance. Any portions of the 53.5 ha (132.2 acres) identified in the County's solicitation that were devoid of woody vegetation ≥ 3 m (9.8 feet) in height (as a result of scouring, restoration activities, etc.) were not surveyed. These areas were described (e.g., species, height, and percent cover of the dominant vegetation), photographed, delineated in the field, and then delineated in ArcGIS. Of the 53.5 ha (132.2 acres) originally estimated for survey by the County, SWCA delineated 47.9 ha (118.4 acres) in 2019 as potential habitat to be surveyed for both species across all subunits; these areas were resurveyed in 2020, although some minor changes were made to the survey area.

During yellow-billed cuckoo surveys in 2019, a cuckoo was detected in a screwbean mesquite (*Prosopis pubescens*)–dominated bosque outside the delineated survey area within Mormon Mesa Parcel 5-A. To better document cuckoo habitat use within this portion of the parcel, SWCA added this 5.1 ha (12.7 acres) of mesquite bosque to the Mormon Mesa 5-A yellow-billed cuckoo survey area in 2020.

In early 2020, the County acquired three new parcels (2-K, 2-L, and 2-M) within the Bunkerville Subunit, totaling an additional 23.9 ha (59.0 acres). SWCA delineated 2.6 ha (6.4 acres) of riparian habitat within Parcels 2-L and 2-M (no habitat was identified in Parcel 2-K) to be surveyed for southwestern willow flycatcher and yellow-billed cuckoo in 2020. In late 2020, the County masticated 14.6 ha (36.1 acres) of dead and dying tamarisk at Mormon Mesa Parcel 5-A. This area of masticated tamarisk was not surveyed for southwestern willow flycatcher or yellow-billed cuckoo in 2021. An additional 16.7 ha (41.3 acres) of tamarisk was masticated in early 2021; this area was not surveyed in 2021, 2022, or 2023. In late 2021, the County acquired two additional parcels (6-A and 6-B) that constitute the Mormon Mesa South Subunit, totaling an additional 48.2 ha (119.1 acres). SWCA delineated 14.3 ha (35.4 acres) along the eastern boundaries of the parcels to be surveyed for southwestern willow flycatcher and yellow-billed cuckoo, and this area was surveyed in 2022 and 2023. During the first round of southwestern willow flycatcher surveys at Bunkerville 2-I and 2-J in May 2022, the habitat in one previously surveyed portion of 2-I was deemed insufficient for southwestern willow flycatcher and yellow-billed cuckoo surveys due to defoliated tamarisk and lack of any continuous canopy. This 1.6-ha (4.0-acre) area was not surveyed in 2022 or 2023.

During the winter of 2022 to 2023, the Bunkerville, Nevada, area experienced higher than average amounts of precipitation (Western Regional Climate Center 2023), which resulted in flooding along the Virgin River. Throughout the spring of 2023, melting of above-average winter snowpack in the Virgin River watershed in Arizona, Nevada, and Utah began to raise water levels significantly in the Virgin River. As a result, vegetation in portions of southwestern willow flycatcher and yellow-billed cuckoo survey areas along the Virgin River was washed away by flood waters; 1.4 ha (3.4 acres) of habitat at Bunkerville Parcel 2-D, 0.01 ha (0.03 acre) of habitat at Bunkerville Parcel 2-I, 0.4 ha (1.0 acres) of habitat at Parcels 2-L and 2-M, and 0.3 ha (0.8 acre) of habitat at Riverside Parcel 3-A were eliminated from southwestern willow flycatcher and yellow-billed cuckoo survey areas in 2023. In 2023,

southwestern willow flycatcher and yellow-billed cuckoo surveys were conducted at the County's Riparian Reserve Units under County project number 2021-SWCA-2020E.

Southwestern willow flycatcher monitoring data collected at Mesquite West from 2003 through 2013 show that southwestern willow flycatcher nest and territory locations varied from year to year, according to the distribution of suitable habitat within the Mesquite West study site, and sometimes were outside the County's Parcel 1-A. Furthermore, monitoring at Parcel 1-A in 2020 resulted in detections of singing male willow flycatchers well west of the County's Parcel 1-A boundary (within Mesquite West West). Therefore, it was determined that southwestern willow flycatcher surveys across the entire Mesquite West site were important for detecting between-year habitat changes and southwestern willow flycatcher movements, as well as for assessing the effects of brown-headed cowbird control on the breeding success of southwestern willow flycatcher across all occupied habitat at Mesquite West. To accomplish these goals, 11.4 ha (28.1 acres) of additional habitat within Mesquite West, generally west of the County's Parcel 1-A, was added to the southwestern willow flycatcher survey area in 2021 and 2022. SWCA continued surveys in this area in 2023 under County project number 2019-SWCA-1935A.

1.2.1.2 SOUTHWESTERN WILLOW FLYCATCHER MONITORING

SWCA has been conducting surveys and monitoring for southwestern willow flycatcher in southern Nevada since 2003, and SWCA has documented southwestern willow flycatcher nesting in Mesquite West (which includes the County's Parcel 1-A) for decades. Over the course of this work, SWCA also documented consistently high rates of parasitism of southwestern willow flycatcher nests by brown-headed cowbird. Surveys and monitoring conducted for the County from 2017 through 2019 documented continued occupancy of Mesquite West by southwestern willow flycatcher throughout those years.

From 2013 through 2019, the Mesquite study area (which encompasses several sites, including Mesquite West) consistently yielded one of the lowest average productivity rates (0.45 fledgling/nest) of all the southwestern willow flycatcher study areas in southern Nevada (SWCA 2019b). Productivity at all southern Nevada sites monitored in 2019 ranged from 0 to 2.5 fledglings/nest, with an overall average of 1.43 fledglings/nest (SWCA 2019b)—over three times greater than at Mesquite West.

SWCA and the County determined that continued monitoring of southwestern willow flycatcher territories and nests would be an essential component in determining whether brown-headed cowbird control had an impact on the nesting success of southwestern willow flycatchers at Mesquite West. SWCA contracted with the County to conduct territory and nest monitoring of southwestern willow flycatchers at Mesquite Parcel 1-A in 2020, and this was expanded to include all of Mesquite West in 2021 and 2022. Additionally, SWCA monitored southwestern willow flycatchers at Mormon Mesa Parcel 5-A in 2021 and 2022, following successful breeding within that parcel in 2020. Nest monitoring results at Parcel 1-A in 2020 and Mesquite West in 2021 and 2022 showed varied results, with productivity ranging from 0 to 1.63 fledglings/nest (SWCA 2022). Territory and nest monitoring continued at Mesquite West and Mormon Mesa Parcel 5-A in 2023 under County project number 2019-SWCA-1935A.

1.2.1.3 BROWN-HEADED COWBIRD CONTROL

It is believed that parasitism has significantly contributed to nest failures and low productivity at Mesquite West (SWCA 2019b). As part of a previous project with the Bureau of Reclamation, SWCA used modified Australian crow traps to passively trap brown-headed cowbirds across the Mesquite study area from 2003 through 2007 (McLeod and Pellegrini 2013). Despite substantial trapping efforts, the percentage of nests that were successful did not significantly improve during or following trapping (pre-trapping: 48%; trapping: 49%; post-trapping: 36%).

Starting in 2010, SWCA began addling brown-headed cowbird eggs on southwestern willow flycatcher projects for the Bureau of Reclamation and the Nevada Department of Wildlife (NDOW). After addling began, the proportion of brown-headed cowbird eggs that hatched dropped from 74% (2003–2009) to 11% (2010–2012) (McLeod and Pellegrini 2013). Nest productivity did not increase significantly as a result of brown-headed cowbird egg addling, possibly because high depredation rates obscured any benefits of egg addling. However, data collected in earlier years showed that nests with unhatched brown-headed cowbird eggs produced more southwestern willow flycatcher fledglings, on average, than did nests with brown-headed cowbird nestlings; therefore, McLeod and Pellegrini (2013) recommended that addling continue to be used as a brown-headed cowbird control method in the Lower Colorado River watershed.

Southwestern willow flycatcher nests in the Mesquite study area had high (51%) nest parasitism rates from 2015 through 2020 (SWCA 2019b, 2020). Rothstein et al. (2003) recommended implementing a brown-headed cowbird control program when parasitism rates reach 20% to 30% for a threatened or endangered host or 50% for non-protected host species. Although trapping or addling alone did not prove beneficial to southwestern willow flycatcher nest success or productivity across Mesquite West, several avian studies have shown an increase in nest success when different means of brown-headed cowbird control were combined, such as shooting adult brown-headed cowbirds, addling brown-headed cowbird eggs, and removing nestling brown-headed cowbirds (Kostecke et al. 2005; Whitfield et al. 1999).

In an attempt to reduce high levels of nest parasitism by brown-headed cowbirds on southwestern willow flycatchers, SWCA proposed a combined-method brown-headed cowbird control program at Mesquite West beginning in 2021, which included brown-headed cowbird egg addling, nestling euthanasia, and target netting. Parasitism rates coinciding with the combined-method brown-headed cowbird treatment program at Mesquite West in 2021 and 2022 were 50% and 22%, respectively. This combined-method brown-headed cowbird control program was continued in 2023 under County project number 2019-SWCA-1935A.

1.2.1.4 POINT-COUNT SURVEYS

In 2017, SWCA began conducting breeding bird point-count surveys for the County at 51 locations across the Riparian Reserve Units (SWCA 2017b). In 2018 and 2019, SWCA continued breeding bird point-count surveys at all or a subset of these locations as part of the comprehensive bird survey effort across all the County's properties (SWCA 2018a, 2019b). Four point-count locations were added with the acquisition of Bunkerville West Parcels 2-K, 2-L, and 2-M in 2020 (SWCA 2020), and four more point-count locations were added at Mormon Mesa South Parcels 6-A and 6-B at the beginning of surveys in 2022. Point-count surveys continued at all Riparian Reserve Units in 2023 under County project number 2021-SWCA-2020E.

1.2.1.5 THERMAL REFUGIA

In 2023, a thermal refugia research component was added to SWCA's contract with the County under project number 2019-SWCA-1935A. The research needs included completing a literature review for information on the thermal requirements for each of the MSHCP-listed riparian bird species (southwestern willow flycatcher, yellow-billed cuckoo, Arizona Bell's vireo, vermilion flycatcher, summer tanager, and blue grosbeak) and collecting temperature data to identify areas of potential thermal refugia for MSHCP-covered species, namely areas where the temperature seemed conducive for southwestern willow flycatcher nesting but did not otherwise meet the species' requirements for reproduction.

1.2.2 Boulder City Conservation Easement

In addition to the acquisition of riparian properties, implementation of the MSHCP required the establishment of a conservation easement in the Eldorado Valley. This easement, known as the BCCE, was established in July 1995 through an agreement between Clark County and Boulder City. Then, in early 2020, the County completed a land exchange for certain portions of the BCCE, resulting in a net increase of 325 ha (803 acres) within the BCCE.

According to both the Biological and Conference Opinion (USFWS 2000) and Condition P of the associated incidental take permit (USFWS 2001), the County is required to take measures necessary to ensure maintenance of connectivity for Mojave desert tortoise (*Gopherus agassizii*) and other covered species within the BCCE. While the BCCE is primarily managed for protection of the desert tortoise, it was recognized that proper management of desert tortoise habitat could also be beneficial for protecting habitat for other species covered by the MSHCP, including avian species (Clark County 2023).

1.2.2.1 POINT-COUNT SURVEYS

In 2018, SWCA began conducting breeding bird point-count surveys for the County at 40 locations across the BCCE (SWCA 2018b). From 2019 through 2022, SWCA continued breeding bird point-count surveys at a subset of these locations as part of the comprehensive bird survey effort across all the County's properties (SWCA 2019a, 2020, 2021, 2022). Point-count surveys continued in 2023 under County project number 2021-SWCA-2020E.

1.3 Management Actions, Goals, and Objectives

The County's Riparian Reserve Unit Management Plan (Clark County 2015) identifies goals and objectives that help guide management directives on the Riparian Reserve Units. The first goal listed in this plan is to "manage reserve units to provide habitat for the six MSHCP covered bird species" (Clark County 2015:35) that use desert riparian habitat. The objective identified to reach this goal is to "restore, create, and enhance habitat for riparian bird species" (Clark County 2015:35). In addition, the BCCE Management Plan (Clark County 2023) identifies goals and objectives that help guide management directives within the BCCE. The second goal listed in the BCCE Management Plan is to "protect and manage the BCCE for other MSHCP covered species" (Clark County 2023). Managing species covered under the MSHCP and their habitats requires an in-depth understanding of baseline conditions within a given management unit. And collecting species abundance and distribution data is a critical first step in monitoring and conserving habitat for the MSHCP-covered bird species. Furthermore, once management actions have been taken, monitoring responses to those actions is integral in determining success or failure of that action. The combined short-term objectives for the projects discussed in this report include both documenting baseline conditions and monitoring responses to management actions; these objectives include 1) to continue building a record of federally listed and non-listed bird species present at the County's reserve system properties, 2) to conduct surveys for southwestern willow flycatcher nesting at Mesquite West and Mormon Mesa, 3) to monitor all southwestern willow flycatcher nests located at Mesquite West and Mormon Mesa and record all successes and failures, 4) to record instances of parasitism by brown-headed cowbirds, 5) to conduct brown-headed cowbird control at Mesquite West throughout the southwestern willow flycatcher breeding season, and 6) to use microclimate dataloggers to identify potential habitat that does not meet the temperature needs for southwestern willow flycatcher reproduction in what seems like otherwise suitable habitat.

The long-term goals are to 1) track changes in the presence and relative abundance of all bird species that use these properties to measure the success of management and restoration efforts conducted therein and 2) maintain and/or improve habitat for the southwestern willow flycatcher and help identify lands where habitat enhancement may be implemented to expand habitat for the southwestern willow flycatcher.

2 METHODS

Surveys and monitoring for the two federally listed birds were conducted by biologists authorized under a USFWS 10(a)1(A) permit (No. PER0009523-2) and an NDOW permit (No. 495754). Bird banding was performed under a federal bird banding permit (No. 23258). Brown-headed cowbird control activities were conducted by personnel authorized under a USFWS 10(a)1(A) permit (No. PER0009523-2), a USFWS Migratory Bird Scientific Collecting Permit (No. PER0038972), and an NDOW permit (No. 495754).

2.1 Federally Listed Bird Surveys

Multiple broadcast surveys for southwestern willow flycatcher conducted throughout the breeding season were used to assess the presence of the southwestern subspecies of willow flycatcher. Southwestern willow flycatcher surveys followed the standard five-survey protocol described in Sogge et al. (2010), which calls for one survey between May 15 and 31, two surveys between June 1 and 24, and two additional surveys between June 25 and July 17. The surveys were separated by a minimum of 5 days. To elicit responses from nearby southwestern willow flycatchers, surveyors stopped approximately every 30 m (98.4 feet) and broadcast 18 seconds of the willow flycatcher's primary song (*fitz-bew*) and call (*breet*). Surveyors watched for willow flycatchers and listened for vocal responses for 1 minute before proceeding to the next survey station. If an unidentified *Empidonax* flycatcher was observed but did not respond with song to the initial broadcast, other conspecific vocalizations were broadcast, including *creets/breets*, *wee-oos*, *whitts*, *churr/kitters*, and a set of interaction calls given by a mated pair of flycatchers (in accordance with Lynn et al. 2003). These calls are frequently effective in eliciting a *fitz-bew* song, thereby enabling surveyors to positively identify willow flycatchers.

Yellow-billed cuckoos vocalize infrequently, have a short breeding cycle, and typically occupy home ranges varying from 40 to 80 ha (100 to 200 acres) in size (USFWS 2020). These factors make it difficult to use survey results to determine the number of cuckoo territories at a site. However, repeated broadcast surveys allow an assessment of the presence or absence of yellow-billed cuckoos, and survey results can be used to estimate the number of possible and probable breeding territories (Halterman et al. 2016).

Yellow-billed cuckoo surveys followed the standard four-survey protocol described by Halterman et al. (2016). One survey was completed between June 15 and 30, two surveys were completed between July 1 and 31, and one survey was completed between August 1 and 15. Surveys were separated by 12 to 15 days. Surveyors stopped every 100 m (328 feet) and listened for 1 minute for spontaneously calling yellow-billed cuckoos, then broadcast five series of yellow-billed cuckoo contact calls (*kuk/kowlp*) at 1-minute intervals. Surveyors listened and watched for yellow-billed cuckoo responses between each set of broadcast calls; the total time spent at each survey point was approximately 6 minutes.

If a willow flycatcher or yellow-billed cuckoo was detected, the observer recorded the location of the bird, the type of detection, and any other pertinent notes. The surveyor then proceeded at least 40 m (131.2 feet) away from any detected willow flycatcher and 300 m (984.3 feet) away from a yellow-billed cuckoo before resuming the survey to avoid double-counting individuals. All surveys commenced at or after first light, when it was light enough for observers to walk safely, and concluded by 10:30 a.m. Pacific Daylight Time (PDT) for southwestern willow flycatcher (Sogge et al. 2010) and by 11:00 a.m.

PDT or when the temperature reached 40 degrees Celsius (ºC) (104 degrees Fahrenheit [ºF])for yellow-billed cuckoo (Halterman et al. 2016). No surveys were conducted if winds exceeded 3 on the Beaufort scale (19.3–30.6 km [12–19 miles] per hour).

Starting points for southwestern willow flycatcher and yellow-billed cuckoo surveys varied between surveys. Standard southwestern willow flycatcher and yellow-billed cuckoo survey summary forms were completed. In addition to completing yellow-billed cuckoo and southwestern willow flycatcher surveys, SWCA recorded qualitative site descriptions for each parcel. Surveyors recorded the dominant vegetation species, visual estimates of vegetation height (to the nearest meter), canopy closure (to the nearest 5%), and qualitative assessments of surface hydrology. Surveys were completed in all areas that were dominated by trees or shrubs ≥ 3 m (9.8 feet) in height (Figures 3–8).

2.2 Southwestern Willow Flycatcher Monitoring

Southwestern willow flycatcher territory and nest monitoring involves more frequent visits to southwestern willow flycatcher territories than do broadcast surveys alone and facilitates locating nests, determining nest fates, and calculating productivity. Territory monitoring commenced at Mesquite West and Mormon Mesa Parcel 5-A once a territorial willow flycatcher was detected. Nest searching and nest monitoring (when appropriate) commenced once a pair of southwestern willow flycatchers was detected. The methods for territory and nest monitoring described herein followed a combination of those described by Rourke et al. (1999), Martin et al. (1997), Martin and Geupel (1993), and Ralph et al. (1993), which recommend monitoring every 2 to 4 days, depending on territory stage and activity.

SWCA conducted southwestern willow flycatcher territory and nest monitoring at each territory approximately every 4 days to determine territory status, locate nests, and monitor known nests. Nests were monitored using a mirror on a telescoping pole to determine nest contents, including any brown-headed cowbird eggs or nestlings. When appropriate, biologists addled brown-headed cowbird eggs, replaced brown-headed cowbird eggs with fake eggs, or removed brown-headed cowbird nestlings from nests (see Sections 2.4.2 and 2.4.3). No nest was mirror poled after nestlings reached 8 days of age to avoid forced fledging.

Nesting attempts were determined to be successful if fledged young were observed in the vicinity of the nest or were identified by their color bands. The number of young produced from each nest was determined by the number of fledglings visually confirmed (not just aurally detected or presumed fledged upon finding an empty nest), resulting in a conservative number of young produced per nest. Fledgling begging calls of many songbird species sound similar, which could be problematic to a biologist when confirming southwestern willow flycatcher fledglings by sound alone; erroneous identification of fledglings could result in inaccurate nest productivity and fecundity calculations. Therefore, only fledglings that were visually located were confirmed to have fledged. Failed nests were inspected to determine the condition of the nest and to record the presence of eggs, eggshells, or dead nestlings in or around the nest. These data were used to determine the stage and cause of nest failure.

Color banding and subsequent resighting can greatly improve the certainty with which individual southwestern willow flycatchers can be associated with a specific territory or nest. Furthermore, color banding nestling southwestern willow flycatchers helps with confirming the number of fledglings produced from each nest and allows for a more accurate determination of nest success and productivity. Color banding involves fitting each flycatcher with an aluminum federal band (either standard silver or anodized in one of several colors) on one leg and a colored, aluminum, pin-striped band on the opposite leg, resulting in a unique color combination of bands.

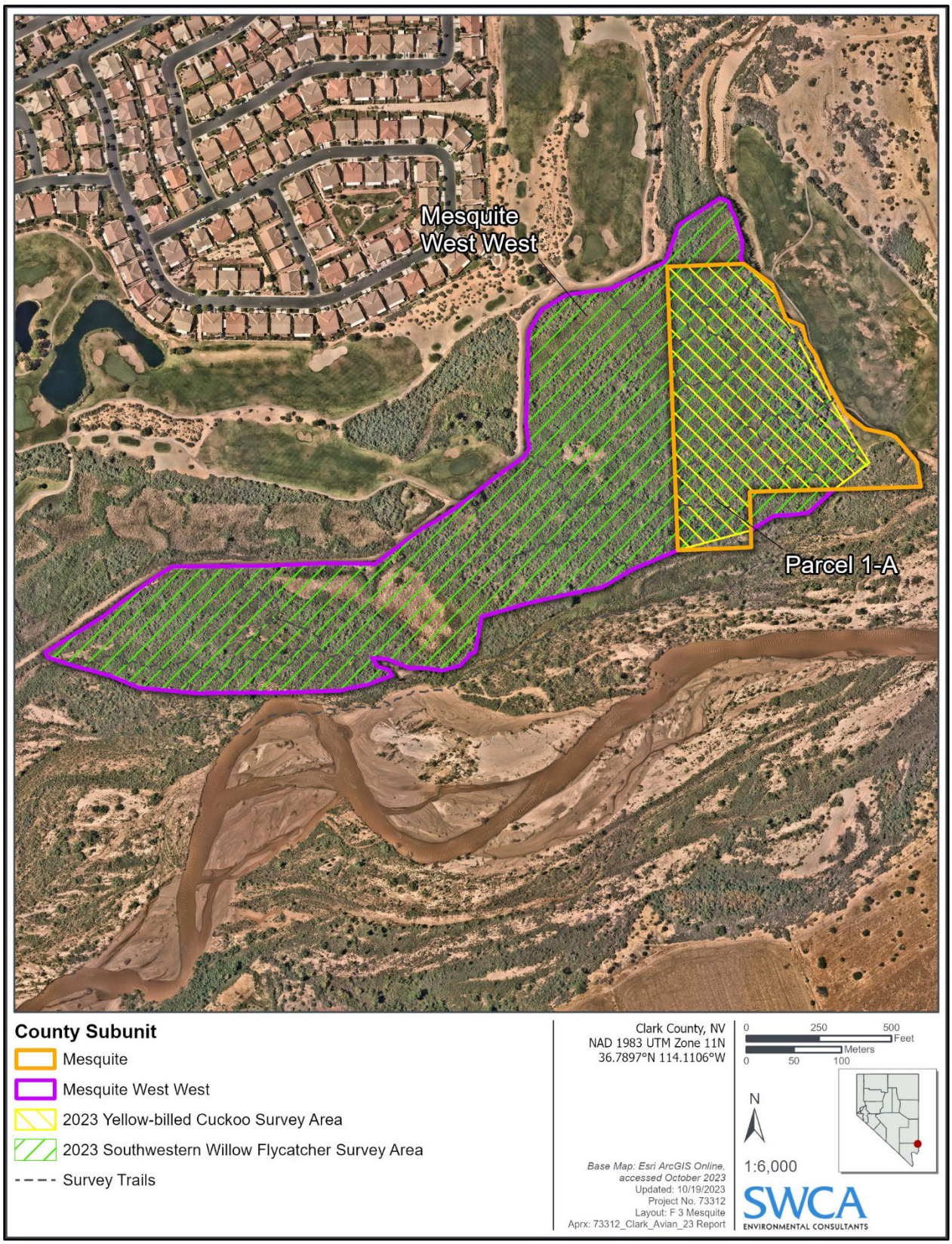

Figure 3. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Mesquite Riparian Reserve Subunit.

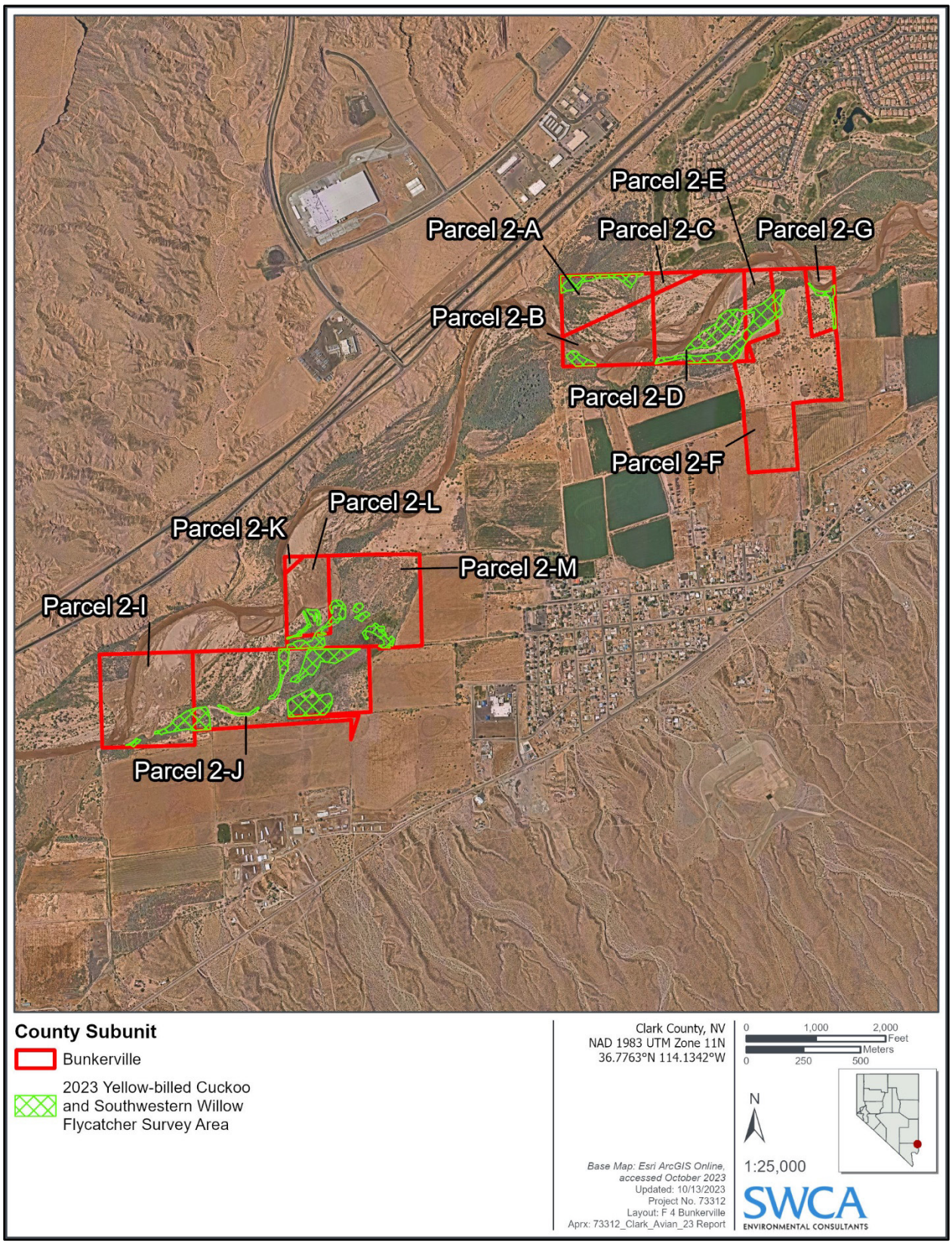

Figure 4. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Bunkerville Riparian Reserve Subunit.

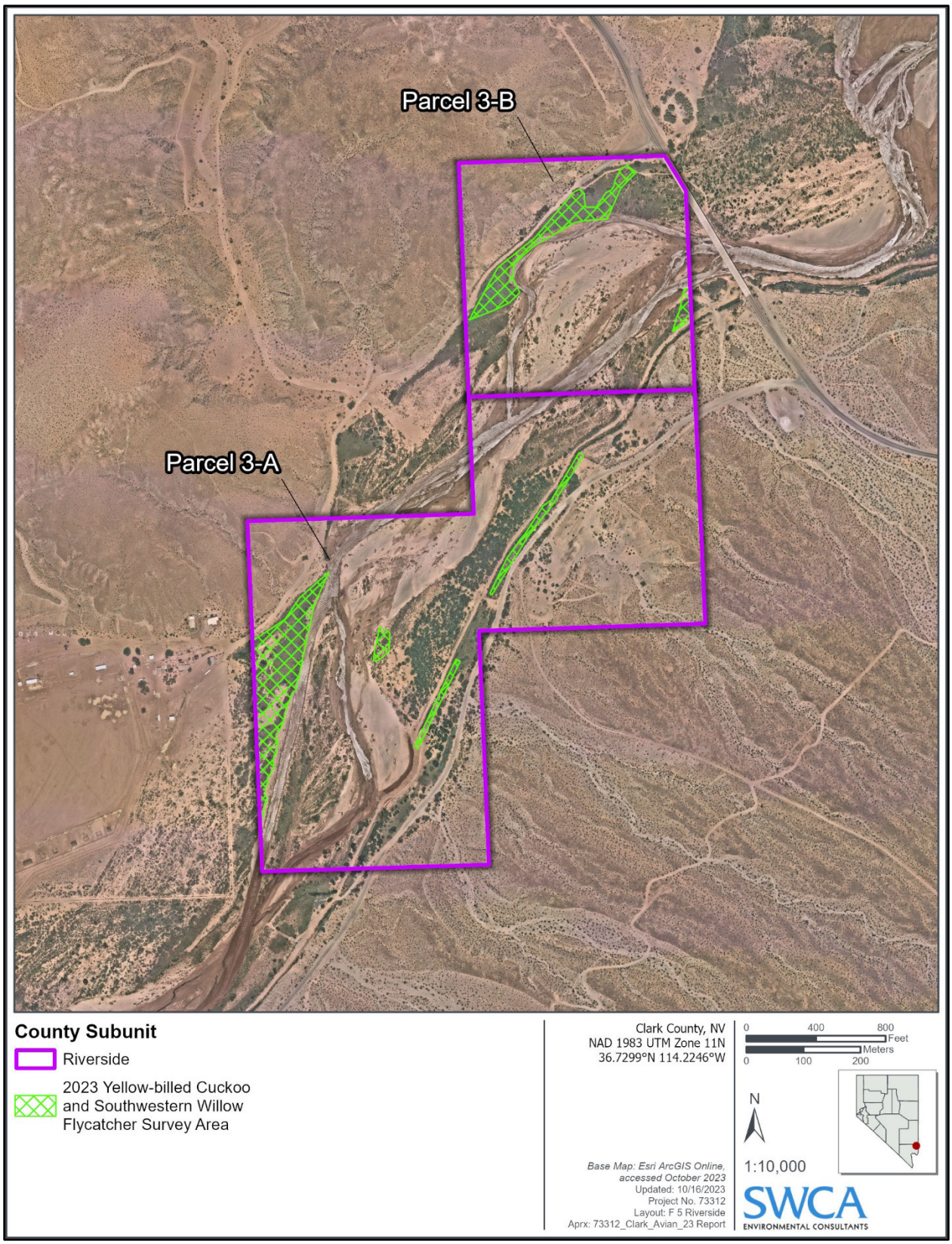

Figure 5. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Riverside Riparian Reserve Subunit.

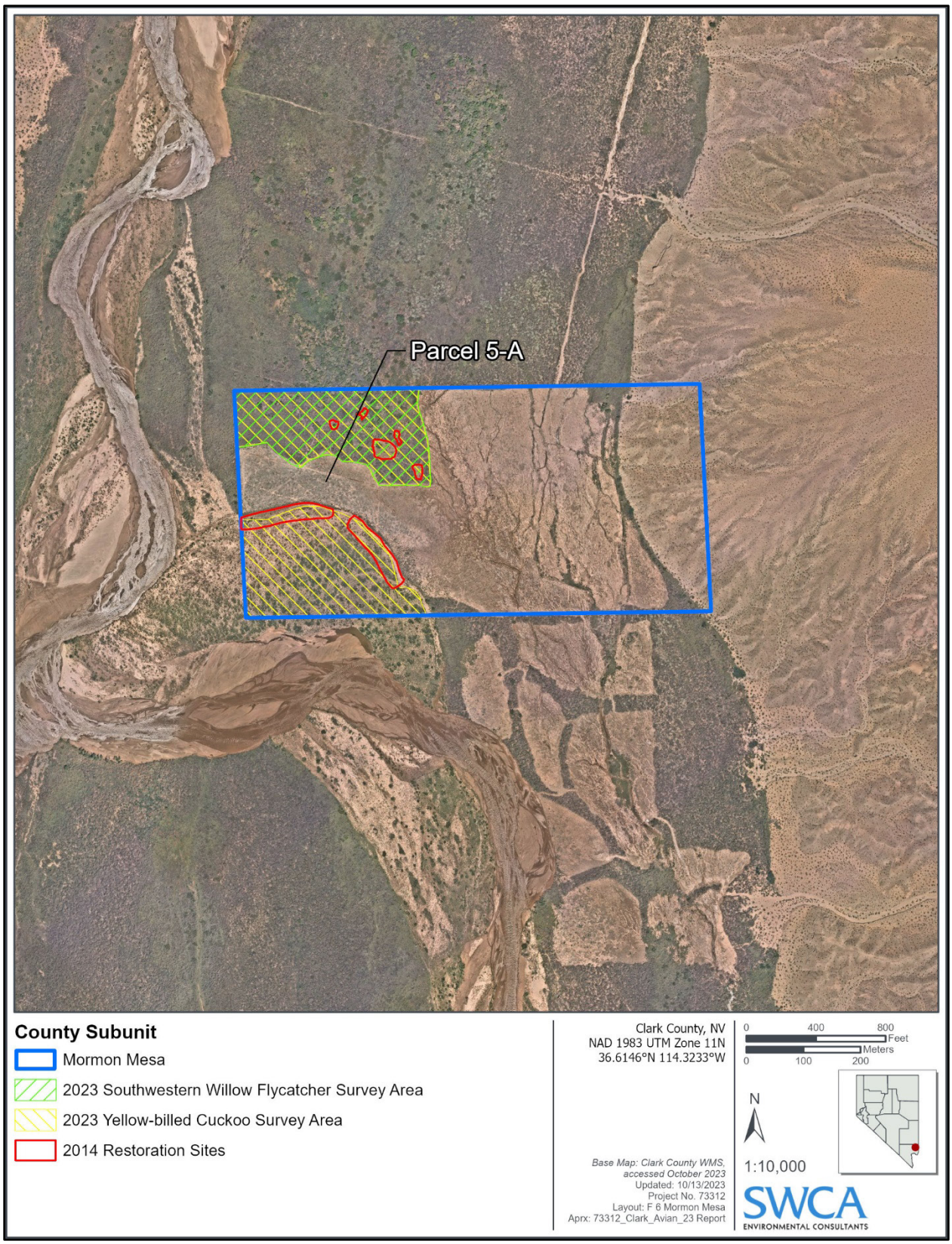

Figure 6. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Mormon Mesa Riparian Reserve Subunit.

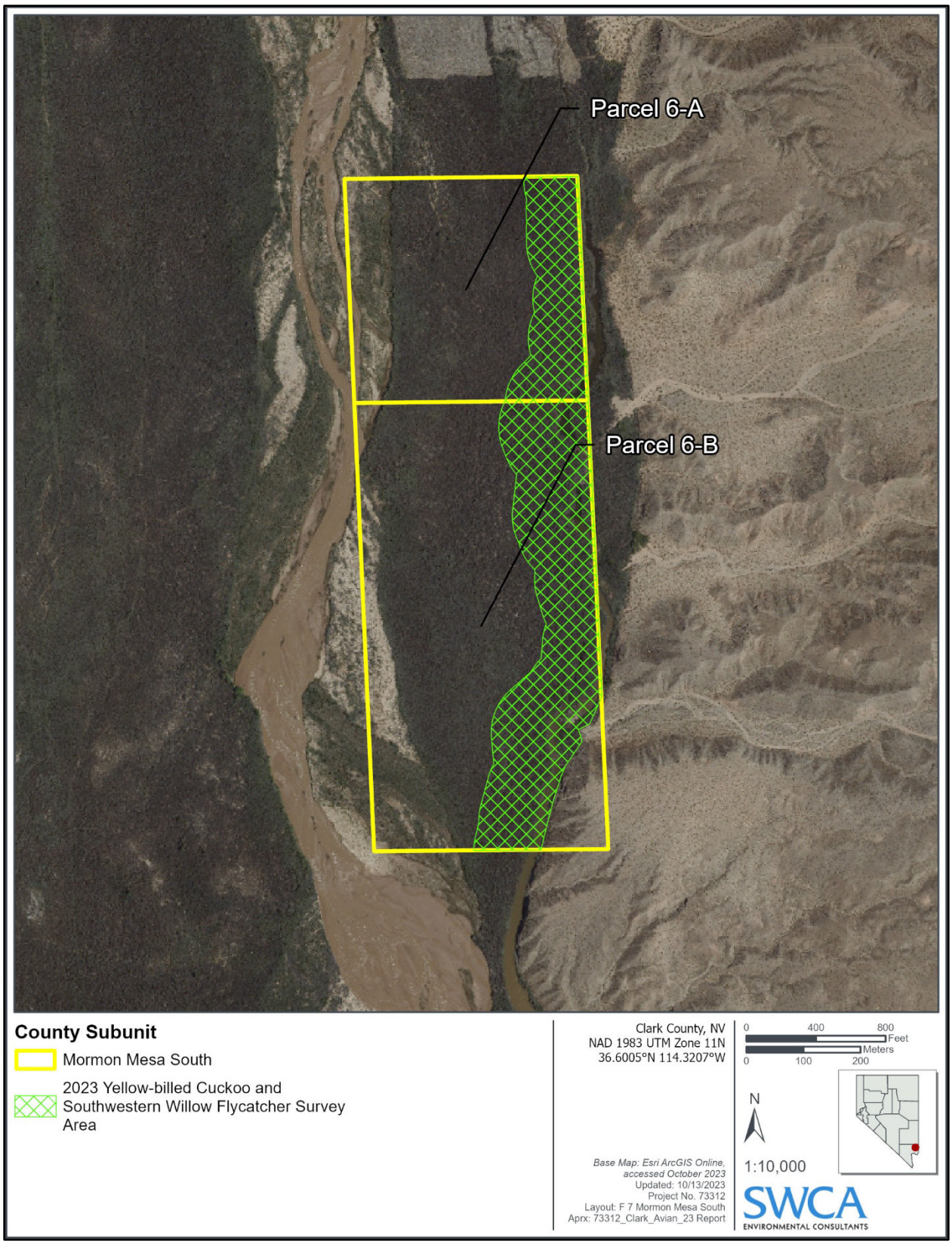

Figure 7. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Mormon Mesa South Riparian Reserve Subunit.

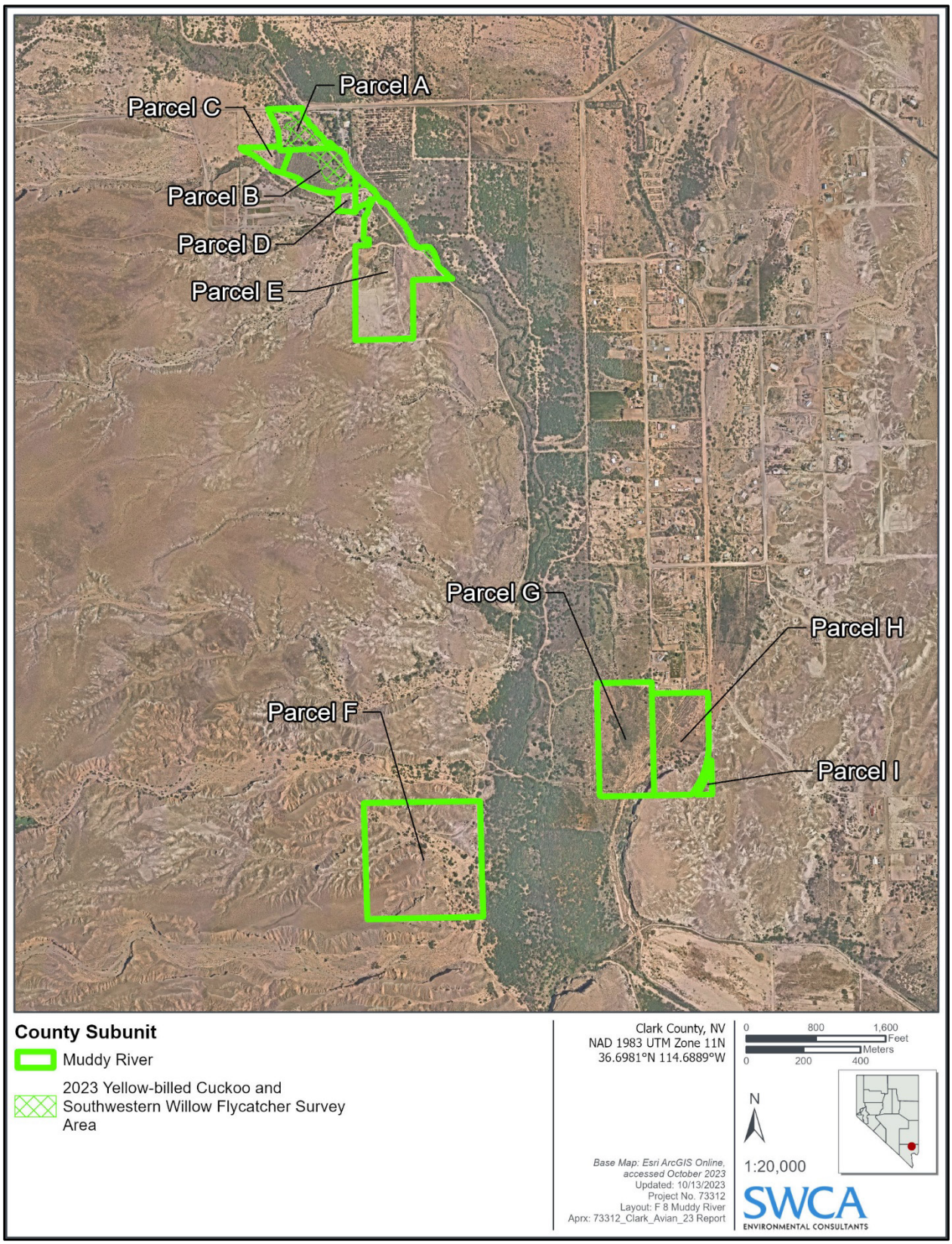

Figure 8. Yellow-billed cuckoo and southwestern willow flycatcher survey areas at the Muddy River Riparian Reserve Unit.

Resighting involves subsequently observing these color bands via binoculars and digital cameras to confirm a bird's identity. Resighting color-banded birds at different times of the season or in subsequent years can also help with understanding movements of southwestern willow flycatchers within and between study areas and sites.

Biologists captured, uniquely color banded, and subsequently monitored adult and nestling southwestern willow flycatchers whenever possible. Adult willow flycatchers were captured with mist nets, which provide the most effective technique for live capture of adult songbirds (Ralph et al. 1993). A targeted capture technique was used (in accordance with Sogge et al. 2001) whereby a variety of conspecific vocalizations were broadcast via MP3 players and remote speakers to lure territorial southwestern willow flycatchers into the nets. Nestlings were banded at 7 to 10 days of age, when they were large enough to retain leg bands, yet young enough that they would not prematurely fledge from the nest (Paxton et al. 1997; Whitfield 1990).

2.3 Data Management for Federally Listed Bird Surveys and Monitoring

For southwestern willow flycatcher and yellow-billed cuckoo surveys and southwestern willow flycatcher monitoring, biologists collected data on Samsung tablets, Samsung phones, or iPhones equipped with Field Maps for ArcGIS and paired with an external GPS receiver. The GPS receiver was capable of submeter accuracy and provided real-time data corrections; data post-processing was not required. Several feature services were published to ArcGIS Online for use in Field Maps. These included site boundaries, trails, a 30 × 30–m (98 × 98–foot) grid, and feature services for field data. High-resolution aerial imagery of all survey sites was also loaded directly onto the tablets for use in Field Maps.

Data collected included point locations of survey points, willow flycatcher and yellow-billed cuckoo detections (e.g., territorial male, territory center, pair, nest, nest flag, or family group), and line features to show the relationship between any two willow flycatcher or yellow-billed cuckoo detection locations (e.g., same bird, different bird, countersinging males, or possible pair). All data collected in the field were recorded into an offline copy of the feature services.

Summary information for each resight and for each territory or nest visit (time in and out of the territory, breeding stage [e.g., single male, pair, nest stage, or no activity], nest contents [if applicable], and behavioral comments) was entered in a form in Survey123 for ArcGIS. Each form was a child feature linked to its respective territory center or nest flag parent point.

All data recorded in Field Maps were synced to and managed in a feature service that resided on the ESRI server. All data on the ESRI server were backed up to an SWCA server periodically and will be stored indefinitely. Quality control features that facilitate identifying common errors were built into Field Maps. All data were reviewed and proofed before data were finalized and delivered to the County.

All spatial data collected in the field, as well as any spatial data provided by the County and edited by SWCA, were exported to a geodatabase and are included as part of the 2023 Final Data Deliverable. A full list of the spatial layers and a description of the data that each layer contains are included in the metadata for the geodatabase. The geodatabase also includes general project information, such as the County project number, the name of SWCA's project manager, the dates for the project, a brief project description, the title of the associated final report, the model of GPS receiver used for the project, and relative positional accuracy.

2.4 Brown-headed Cowbird Control

2.4.1 Target Netting

Brown-headed cowbird target netting commenced at Mesquite West just prior to the beginning of the southwestern willow flycatcher breeding season (i.e., early May) in anticipation of the site being occupied by southwestern willow flycatchers. Target netting employed broadcasts of conspecific vocalizations to lure brown-headed cowbirds into a mist net. Each target-netting attempt consisted of erecting a single mist net 2.6 m (8.5 feet) in height with 38-mm (1.5-inch) mesh size and placing a female brown-headed cowbird decoy near the midpoint of the net. A small, portable speaker was placed near the decoy, and a second speaker was placed on the opposite side of the net. These speakers were coupled to MP3 players loaded with multiple tracks of brown-headed cowbird vocalizations.

Once the net was erected and the decoy and speakers were set in place, the observer hid approximately 10 m (32.8 feet) from the net in a place with a full view of the net. The observer began broadcasting a female brown-headed cowbird chatter vocalization, with periodic pauses to mimic a natural vocalization rate, until a female brown-headed cowbird came near the net. Once a female brown-headed cowbird was in sight, different tracks were played to agitate the female and draw her into the net. Any male brown-headed cowbird or non-target species that was caught in the net was removed immediately and released. The observer clipped the tail of each male brown-headed cowbird in a "swallow pattern" prior to release to signify that the bird had been previously captured, should the bird be caught again later in the season. All female and juvenile brown-headed cowbirds were euthanized via decapitation, a method approved under the current American Veterinary Medical Association guidelines for euthanizing small birds (American Veterinary Medical Association 2020).

2.4.1.1 NET LOCATIONS

Mist nets were placed in semi-open areas at least 70 m (230 feet) from all known southwestern willow flycatcher nests or territory centers, which resulted in net locations being approximately 50 m (164.0 feet) or more from the edge of those occupied territories. Because SWCA also conducted territory and nest monitoring for southwestern willow flycatcher at Mesquite West in 2023, biologists attempting to net brown-headed cowbirds had access to current information on all willow flycatcher detection, territory, and nest locations. All mist-net locations were approached from a direction that did not cause the observer to pass through or near a southwestern willow flycatcher territory.

Female brown-headed cowbirds can occupy territories of 4.5 ha (11.1 acres) or greater (Lowther 2020), which is a much larger area than a typical southwestern willow flycatcher territory (less than 0.5 ha [1.2 acres]) (Cardinal 2005); thus, placing netting attempts between 50 and 100 m (164 and 328 feet) from the edge of southwestern willow flycatcher territories targeted female brown-headed cowbirds whose ranges likely overlapped southwestern willow flycatcher territories. Placing all netting attempts outside southwestern willow flycatcher territories minimized the chance of inadvertently capturing a southwestern willow flycatcher or drawing a brown-headed cowbird into a southwestern willow flycatcher territory. However, because it was still possible that a southwestern willow flycatcher could be captured during brown-headed cowbird target netting, all biologists who attempted to target net brown-headed cowbirds were also authorized through SWCA's existing 10(a)1(A) permit (No. PER0009523-2) and Master Banding permit (No. 23258) to handle southwestern willow flycatchers.

2.4.1.2 TIMING OF NETTING ATTEMPTS

Any netting attempt that failed to attract female brown-headed cowbirds to the vicinity was terminated after 1 hour. The first netting attempt of the day began as early as first light, allowing for multiple netting

attempts in a day. Female brown-headed cowbirds are typically on their laying territories in the early morning; thus, morning netting attempts targeted those brown-headed cowbirds likely to parasitize hosts in the vicinity. Netting attempts were terminated by 10:00 a.m. PDT, and no netting attempts were conducted during inclement weather or with direct sunlight on the net. The net was removed at the conclusion of each netting attempt. Netting attempts began in early May and were conducted twice per week through May 27, then at least once per week through the end of July. Starting target netting for brown-headed cowbirds in early May allowed for four netting visits prior to the initiation of the earliest southwestern willow flycatcher nests.

2.4.2 Egg Addling and Replacement

When an accessible southwestern willow flycatcher nest was parasitized on or before the fifth day of incubation, the brown-headed cowbird egg(s) was either addled via vigorous shaking or replaced with a fake egg painted to resemble the speckled pattern of a brown-headed cowbird egg. Brown-headed cowbird eggs were not removed from the nest so as not to mimic a partial depredation event, which could cause nest desertion. Shaking brown-headed cowbird eggs greatly reduces the chance of the egg hatching, and there is no evidence that this activity results in nest desertion (McLeod and Pellegrini 2013; McLeod et al. 2018). If a ladder was necessary to access the brown-headed cowbird egg without causing damage to the nest, the egg was addled or replaced with a fake egg on the next visit to the site.

2.4.3 Nestling Euthanasia

Brown-headed cowbird nestlings may be present in a southwestern willow flycatcher nest either when the nest is found or after an addling attempt has failed and the brown-headed cowbird egg hatches. If a brown-headed cowbird nestling was discovered in a nest, the nestling was removed. If the nest was accessible without a ladder, the nestling was removed at the time of discovery. If a ladder was necessary to remove the nestling without causing damage to the nest, the nestling was removed on the next visit to the site.

2.5 Point-Count Surveys

Surveys conducted in 2023 followed methods used during the 2017 through 2022 point-count surveys (SWCA 2017b, 2018a, 2018b, 2019a, 2020, 2021, 2022), which applied established point-count protocols and drew from methods described in *A Habitat-based Monitoring Program for Breeding Birds of Nevada* (Great Basin Bird Observatory [GBBO] 2003) and in the *Handbook of Field Methods for Monitoring Landbirds* (Ralph et al. 1993).

In 2019, SWCA randomly selected 25 of the 51 previously established point-count locations across the Riparian Reserve Units to be surveyed in odd-numbered years (i.e., 2019, 2021, 2023); the remaining 26 points were selected to be surveyed in even-numbered years (i.e., 2020, 2022) (Figures 9–14). In 2020, the County added four survey points in Parcels 2-L and 2-M, two to be surveyed in odd years and two to be surveyed in even years. In 2022, another four points were added in Parcels 6-A and 6-B, two to be surveyed in odd years and two to be surveyed in even years.

In 2019, above-average winter precipitation yielded abnormally high water levels along the Virgin River. As a result, two of the riparian point-count locations scheduled for surveys in odd years were inundated by the active river channel, and these point-count locations were repositioned (BV-18a and RS-7a). The survey location for BV-18 was subsequently returned to its original location once the water receded, but RS-7a has remained as the new location for that point count ever since (see Figure 11). None of the point-count locations established for even years were affected by the high water levels.

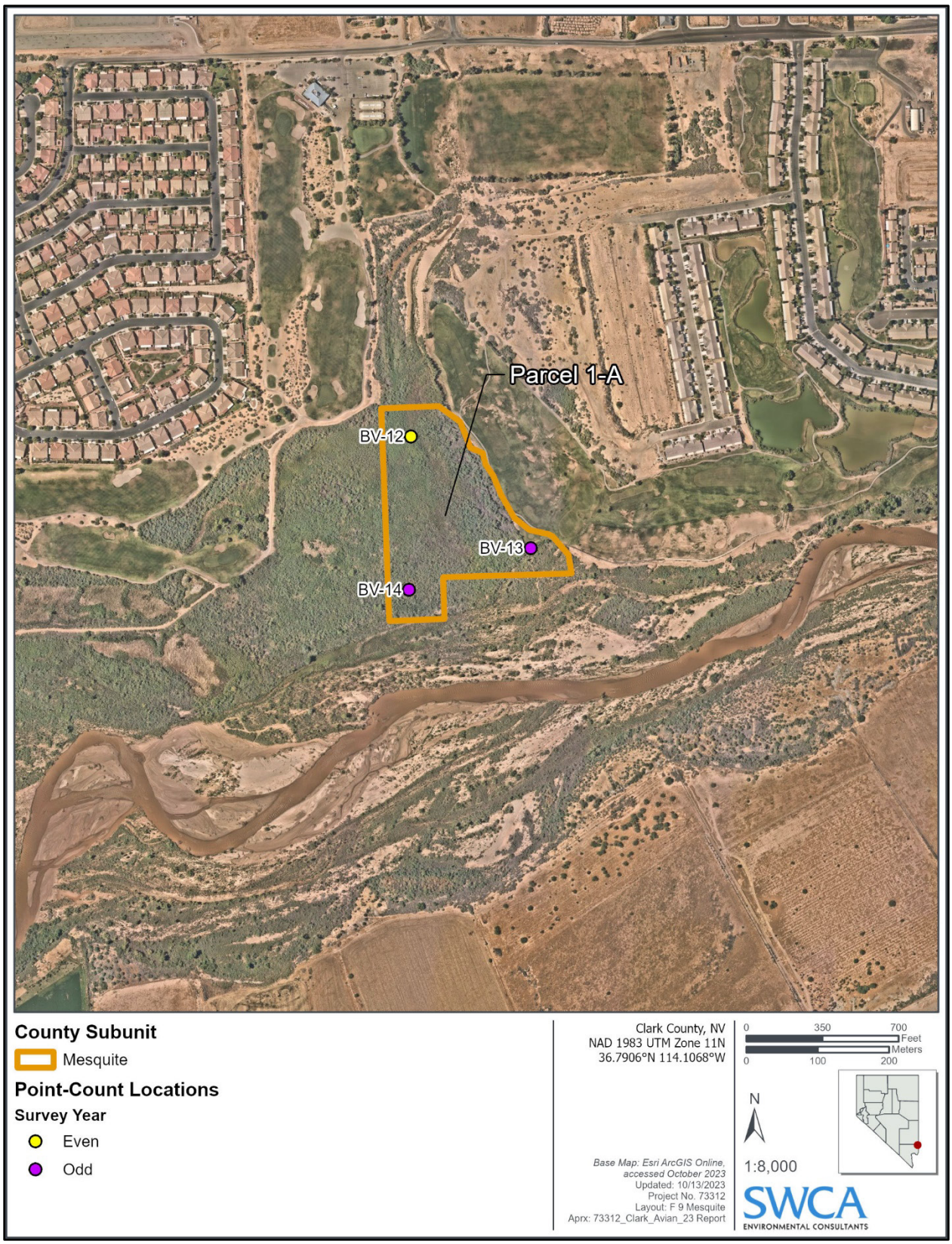

Figure 9. Point-count locations within the Mesquite Riparian Reserve Subunit.

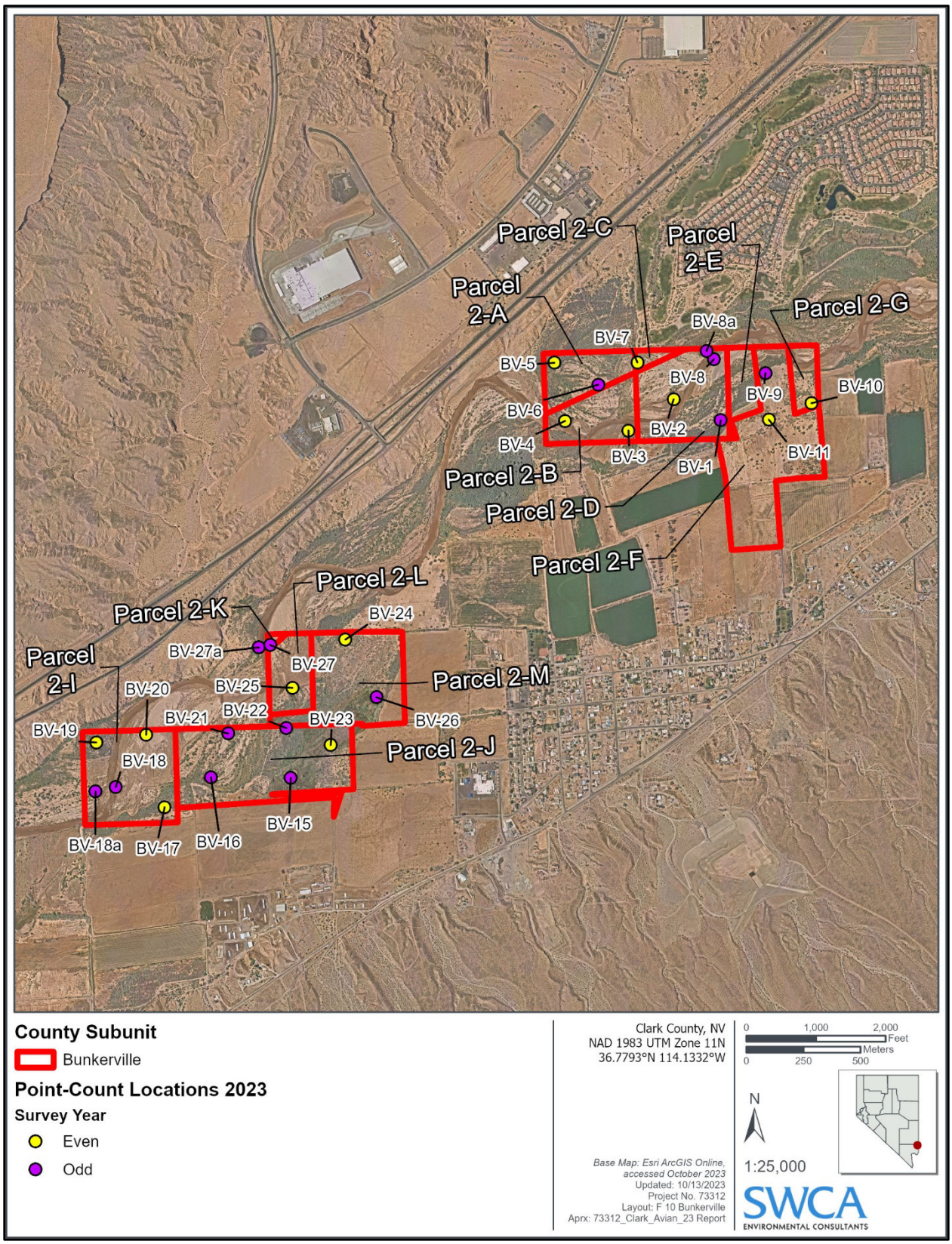

Figure 10. Point-count locations within the Bunkerville Riparian Reserve Subunit.

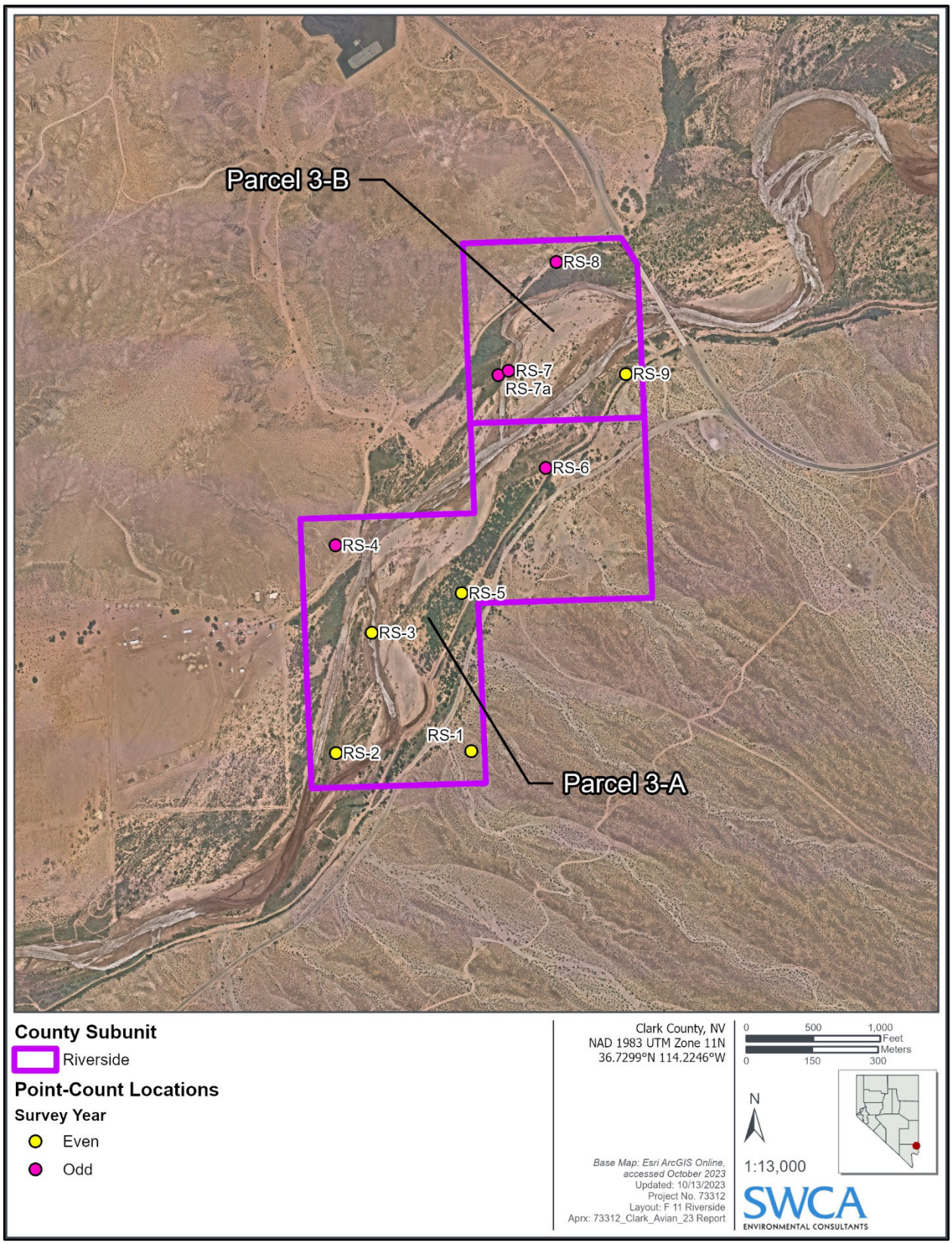

Figure 11. Point-count locations within the Riverside Riparian Reserve Subunit.

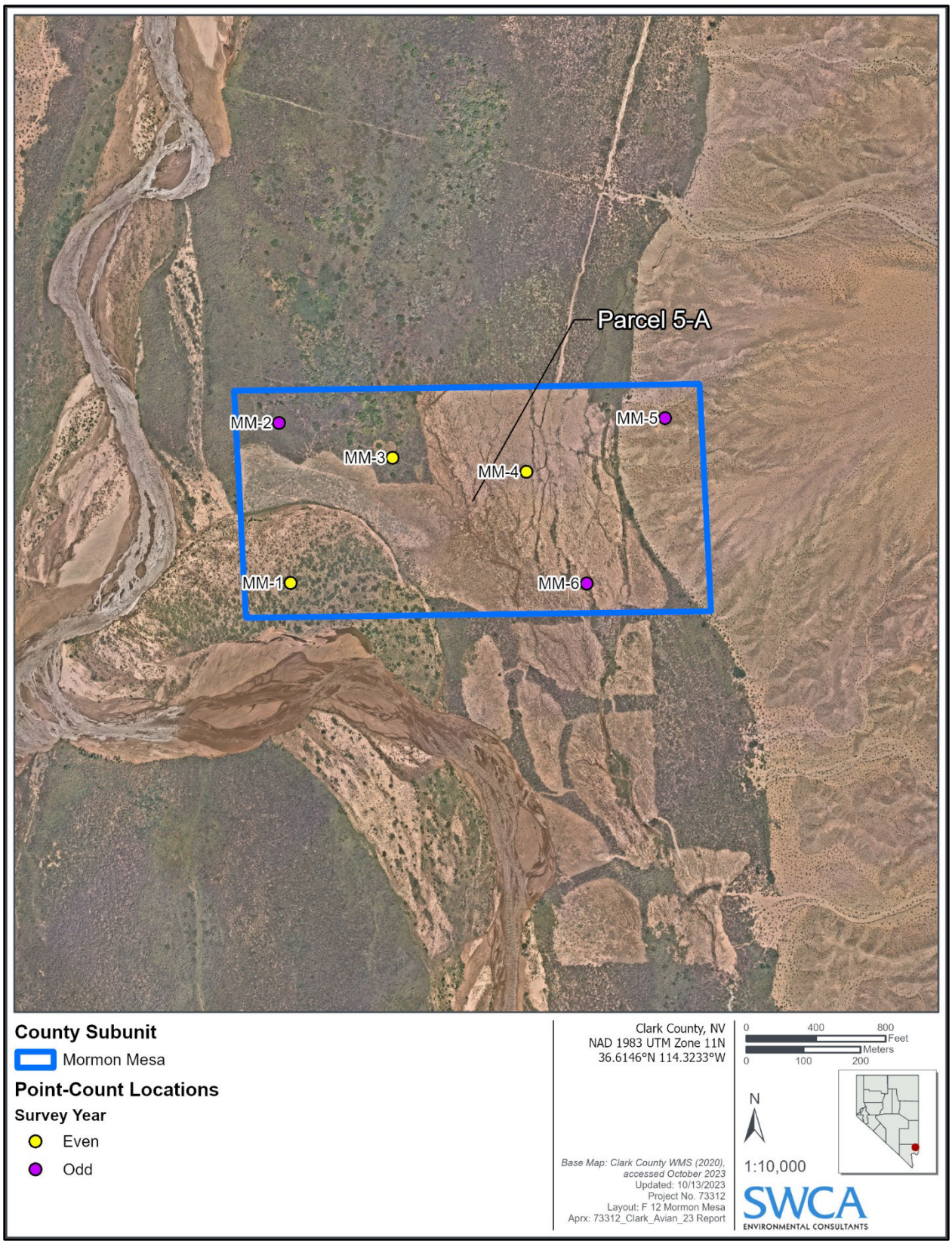

Figure 12. Point-count locations within the Mormon Mesa Riparian Reserve Subunit.

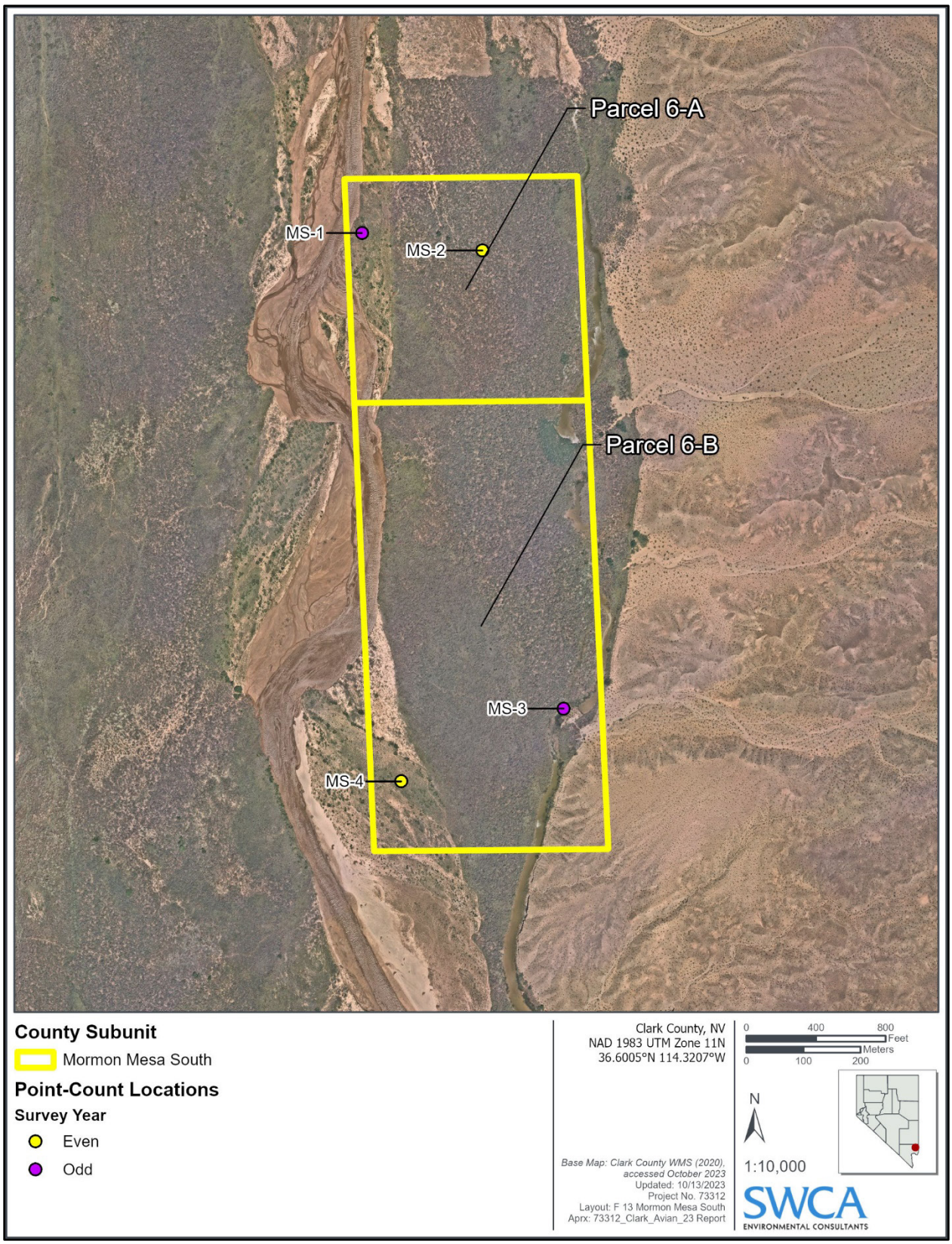

Figure 13. Point-count locations within the Mormon Mesa South Riparian Reserve Subunit.

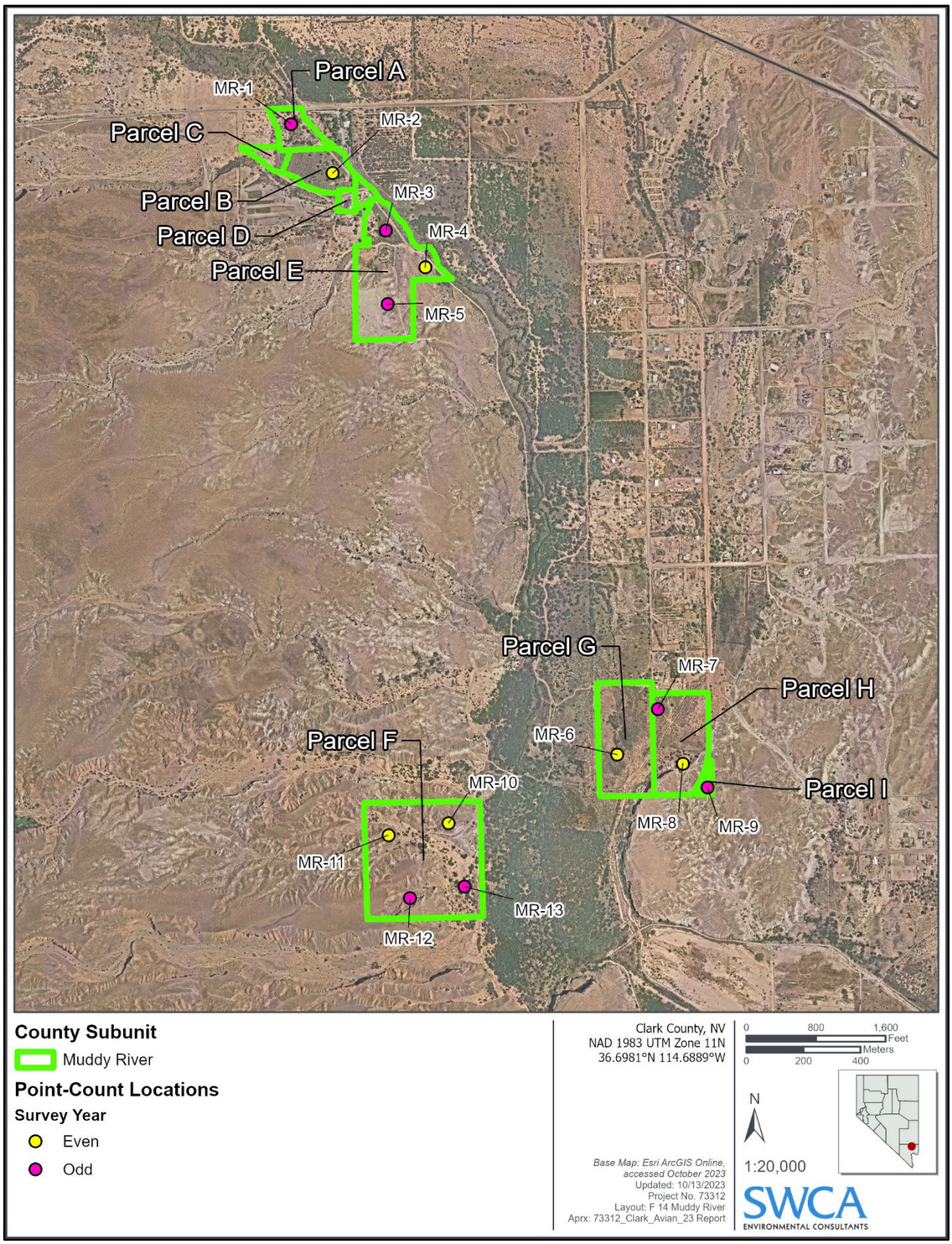

Figure 14. Point-count locations within the Muddy River Riparian Reserve Unit.

In 2023, SWCA conducted avian point-count surveys at the 29 even-year point-count locations. Prior to the commencement of surveys, biologists conducted a site reconnaissance to assess site conditions following winter and spring flooding and to identify any impediments to access. During the reconnaissance, biologists navigated to each survey point and marked each with flagging so that it could be easily located on subsequent visits. High water levels along the Virgin River once again inundated BV-18, and it could not be accessed for point-counts during the first round of surveys; therefore BV-18a was used for the first round of surveys, but BV-18 was accessible for the second and third rounds of point counts. Two additional point-count locations (BV-8 and BV-27) were repositioned due to flooding (see Figure 10). The area surrounding BV-8 was scoured, and therefore BV-8a was used for all three rounds of point counts in 2023. Inundation prohibited access to BV-27, and BV-27a was used during the first and second rounds of surveys; flood water later receded, and BV-27 was accessible for the third round of point counts.

In 2019, SWCA randomly selected 20 of the 40 previously surveyed point-count locations at the BCCE to be surveyed in odd-numbered years (i.e., 2019, 2021, 2023); the remaining 20 locations were selected to be surveyed in even-numbered years (i.e., 2020, 2022) (Figure 15). As it was anticipated that conditions at the BCCE had not changed dramatically since 2021, no field reconnaissance was completed prior to field surveys at that property in 2023. Surveyors were able to access all 20 of the previously surveyed point-count locations without impediment, and all the original locations assigned to odd-numbered years were used in 2023.

Each surveyor followed standard unlimited-radius point-count procedures, with surveys starting at sunrise and concluding by 10:00 a.m. PDT (GBBO 2003; Ralph et al. 1993). Consecutive surveys at each point were separated by a minimum of 7 days. The order in which a group of point counts was completed was alternated between each round of surveys so that a given point was not always surveyed at the same time of day.

For each survey, the surveyor approached each point quietly to avoid overly disturbing any birds present. Prior to or immediately following each point count, the surveyor recorded weather data, including cloud cover, wind speed and direction, temperature, and precipitation, on a standardized form. No surveys were conducted when wind speeds exceeded 40 km (25 miles) per hour or during periods of heavy rain, as both conditions could have inhibited the comprehensive inventory of a survey area (GBBO 2003).

Point counts consisted of a 10-minute observation period, which was broken into four time intervals (0–3, 3–5, 5–8, and 8–10 minutes). Surveyors noted the time interval in which the first detection of a given bird or group of birds was made. For each detection, surveyors also recorded species code, sex, age, estimated distance from the observer, bearing to the bird(s), and behavior of the bird(s) as it pertained to its breeding status. Any bird(s) that flushed as the surveyor approached the point-count location but that was not detected during the survey was recorded as observed during the 0- to 3-minute interval and in the location from where it flushed. All detections were recorded on hardcopy datasheets, and bird locations were plotted on a standard point-count map (with their associated behavior codes) to help avoid double-counting individuals within a survey location. Any bird that gave an unknown vocalization was tracked following the survey to determine its identity (Ralph et al. 1993).

2.6 Thermal Refugia

Deployment of Maxim Integrated Products, Inc. DS1923 iButton temperature/humidity loggers (hereafter "iButton datalogger" or "datalogger") across the County's Riparian Reserve Units began in late May. These dataloggers were placed 1) near southwestern willow flycatcher nests, 2) in areas that appeared to be suitable for flycatcher nesting but where nesting has not been observed in recent years, and 3) in a representative variety of riparian habitats in the County's Riparian Reserve Units.

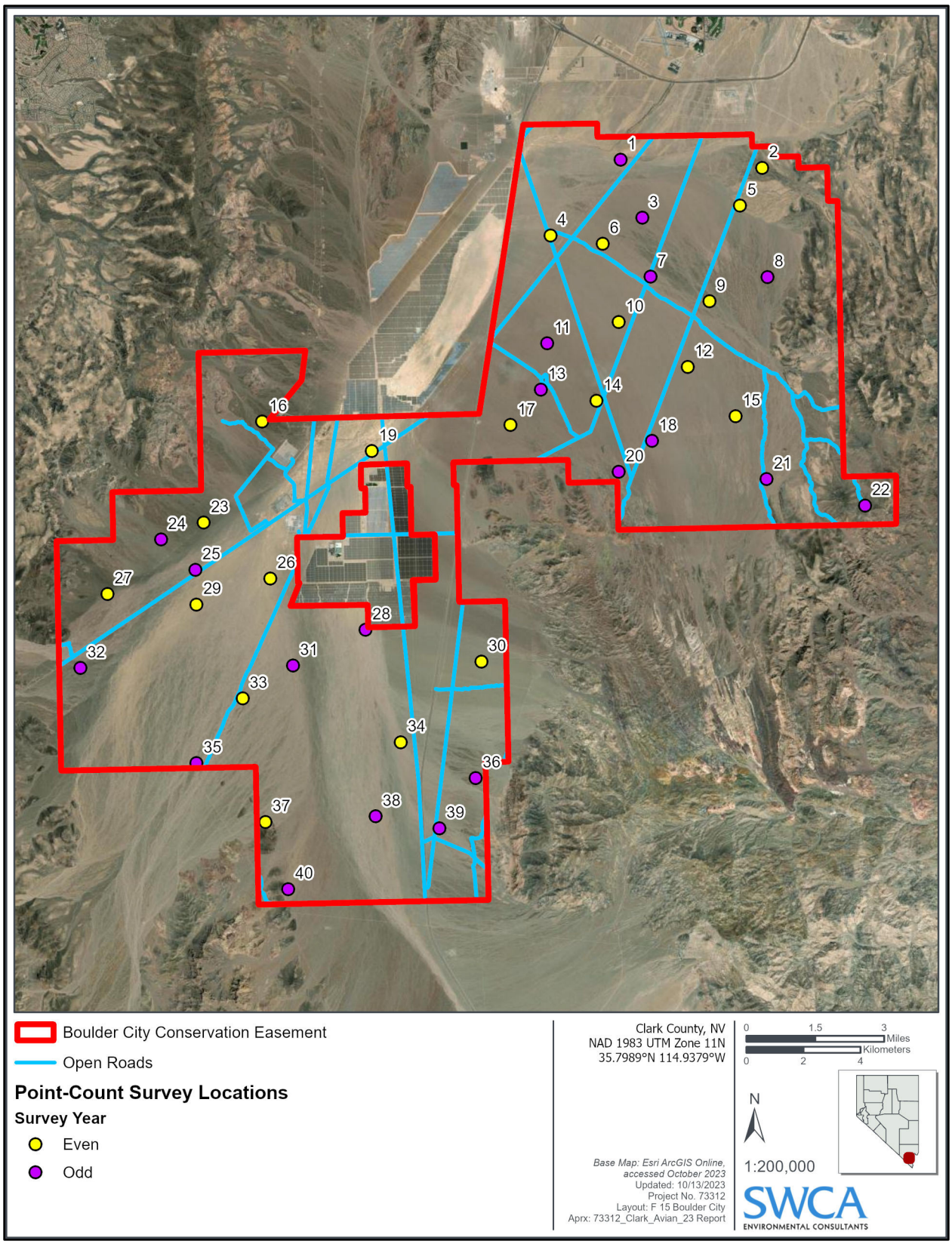

Figure 15. Point-count locations within the BCCE.

Dataloggers were deployed at southwestern willow flycatcher nests (SWFL nests, N = 10) at Mesquite West and at Mormon Mesa Parcel 5-A as soon as the nesting attempt progressed beyond the laying stage (Figures 16 and 17). Each datalogger was hung by a length of flexible wire in an inconspicuous location within 2 m of the nest. Additional dataloggers were deployed in areas that appeared to be suitable for nesting southwestern willow flycatcher (i.e., canopy closure ≥ 85%, canopy height ≥ 4 m, and moist soils) but were unoccupied (i.e., no southwestern willow flycatcher territory centers or nests within approximately 50 m (164.0 feet) at the time the datalogger was hung) (unoccupied SWFL habitat, N = 10) (Figures 18 and 19; see Figures 16 and 17). Willow flycatchers were detected within 50 m (164.0 feet) of unoccupied SWFL habitat dataloggers after they were placed at two locations; the nests at territory 13 (13A/13A2) were located 41 m (134.5 feet) from datalogger 9D62, and floater 14 (F14) was briefly detected 35 m (114.8 feet) from datalogger 25F9 (see Figure 16, Appendix A: Figure A-1). The remaining dataloggers were placed in riparian habitats that did not resemble southwestern willow flycatcher breeding habitat but where other MSHCP-listed species were recorded during at least one of the first two rounds of point-count surveys or incidentally while conducting other work at the County's Riparian Reserve Units (MSHCP species habitat, N = 22) (Figure 20; see Figures 16–19). Dataloggers in MSHCP species habitat were placed at or near detections of Bell's vireo, blue grosbeak, crissal thrasher, or phainopepla. These four species are relatively ubiquitous across the Riparian Reserve Units and are known to use scrubbier, more open habitats—frequently dominated by arrowweed (*Pluchea sericea*) and/or mesquite—than those used by southwestern willow flycatcher.

All dataloggers placed in unoccupied SWFL habitat and 14 of the 22 dataloggers placed in MSHCP species habitat were deployed by May 31, 2023; the remaining eight dataloggers placed in MSHCP species habitat were placed between June 5 and June 22. Dataloggers at SWFL nests were placed between June 9 and July 26. Dataloggers were programmed to collect 8-bit temperature and relative humidity readings every 30 minutes and were deployed until August 15.

The temperature and relative humidity data collected by the dataloggers were evaluated in the following ways:

- Visually—Raw temperature and relative humidity data were visually examined for patterns using density plots (i.e., the relative frequency of measurements), parsed by month
- Statistically—Data were tested for statistical differences in temperature and relative humidity between SWFL nests and MSHCP species habitat in June, July, and August
- Comparatively—Dataloggers were ranked for similarity of the monitored unoccupied SWFL habitats to SWFL nests based on temperature and relative humidity

The visual evaluation was completed by constructing density plots (ggplot2 in R) of the individual temperature measurements by month and habitat type. This initial result was used to describe broad patterns in the data and to develop a focused set of hypotheses for statistical testing.

The statistical evaluation of the following hypotheses was completed using linear mixed effects models (lme4::lmer in R), which accounted for the random effects of site and date:

- The daily maximum temperature is significantly higher in MSHCP species habitat than at SWFL nests during the nesting season (tested for June through August and for each month individually)
- The daily mean temperature is significantly higher in MSHCP species habitat than at SWFL nests during the nesting season (tested for June through August and for each month individually)
- The daily mean humidity is significantly lower in MSHCP species habitat than at SWFL nests during the nesting season (tested for June through August and for each month individually)

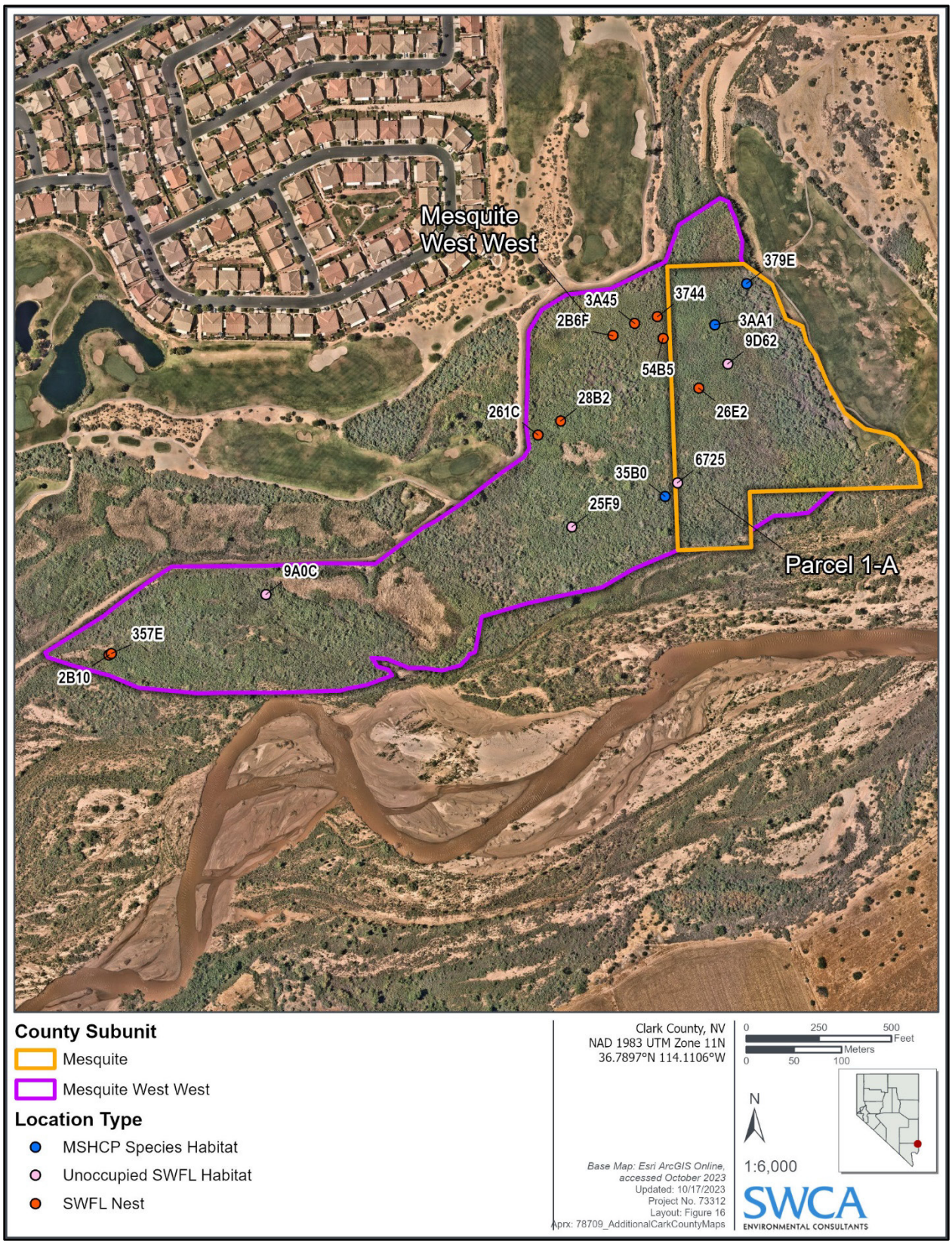

Figure 16. Datalogger locations at Mesquite West.

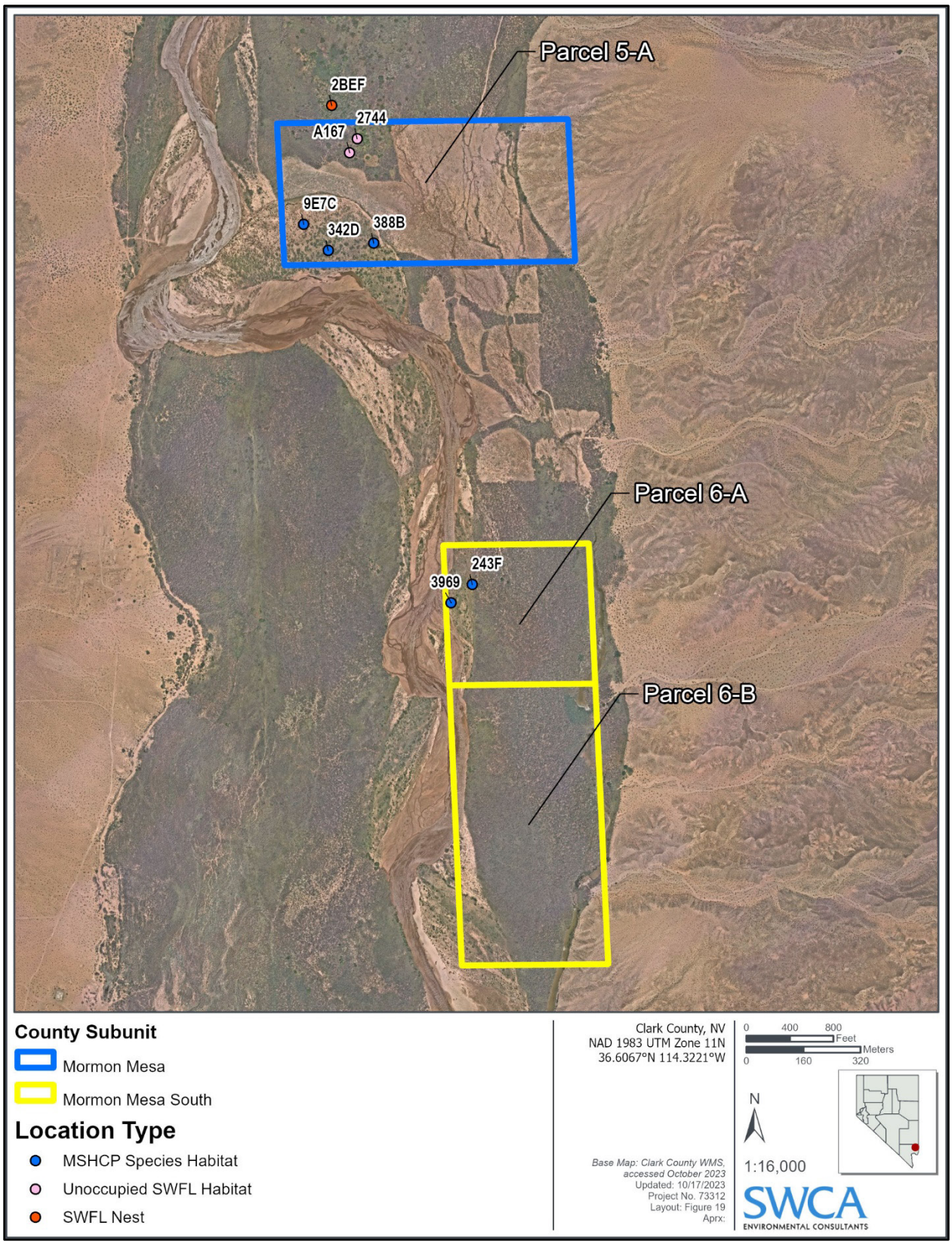

Figure 17. Datalogger locations at Mormon Mesa.

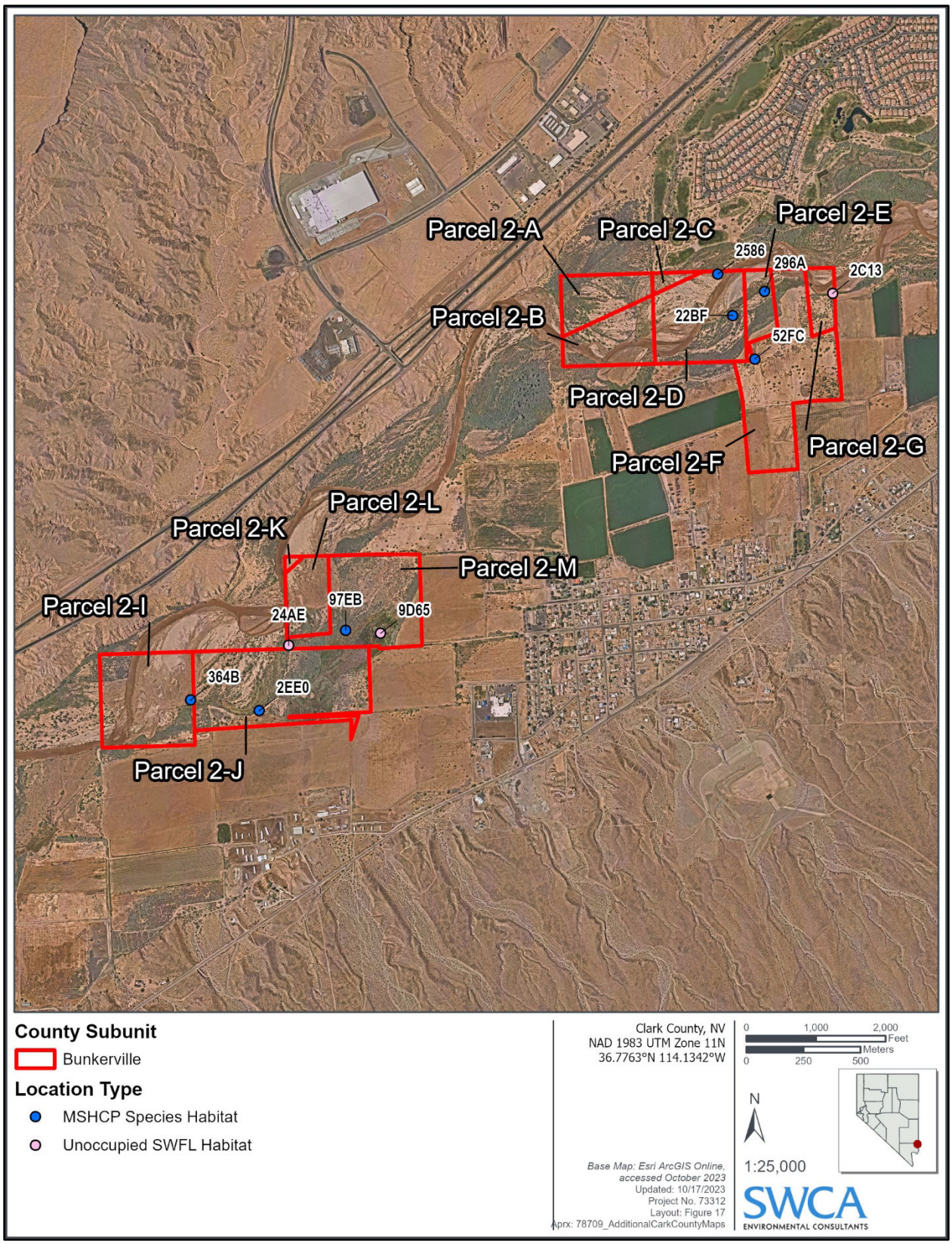

Figure 18. Datalogger locations at Bunkerville.

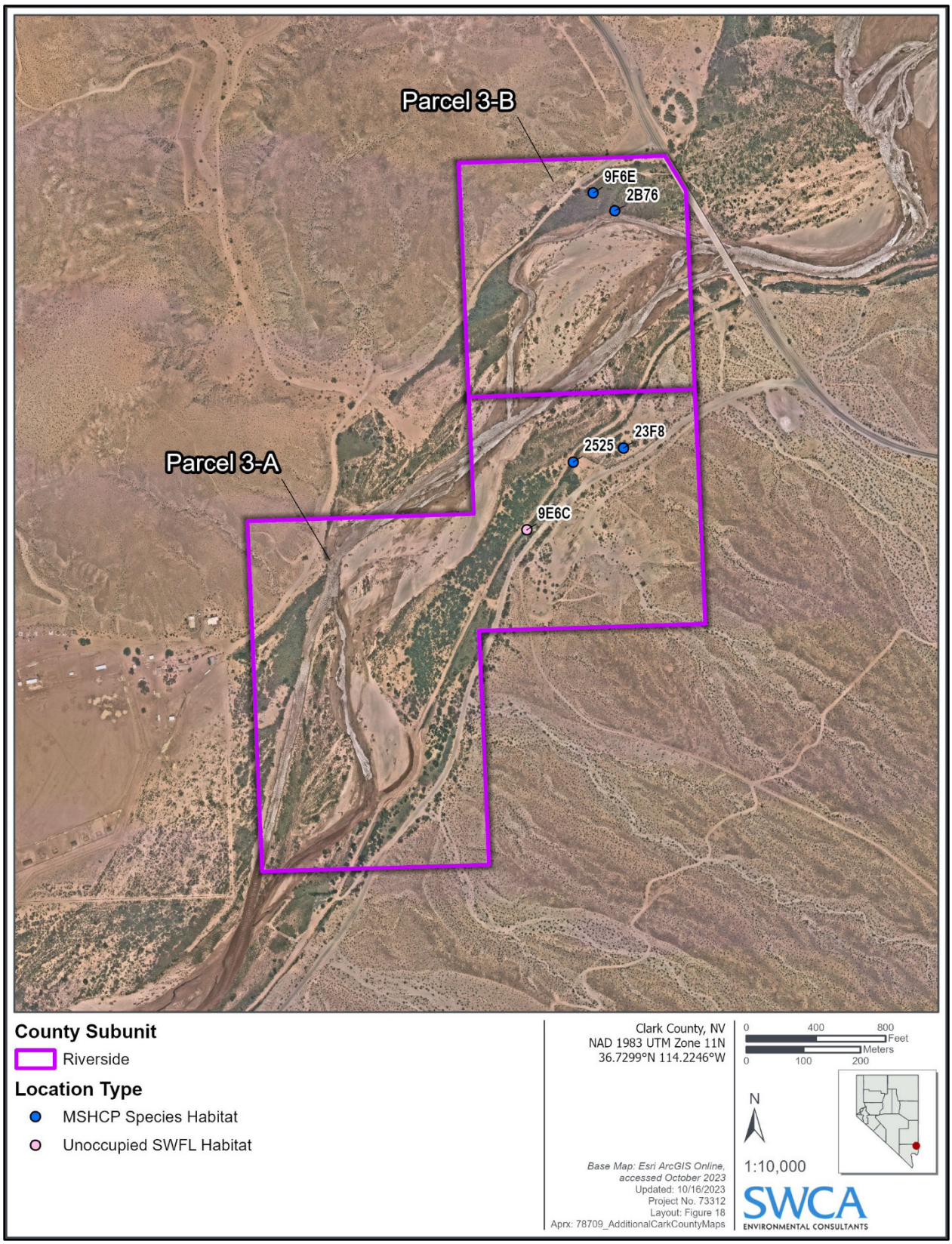

Figure 19. Datalogger locations at Riverside.

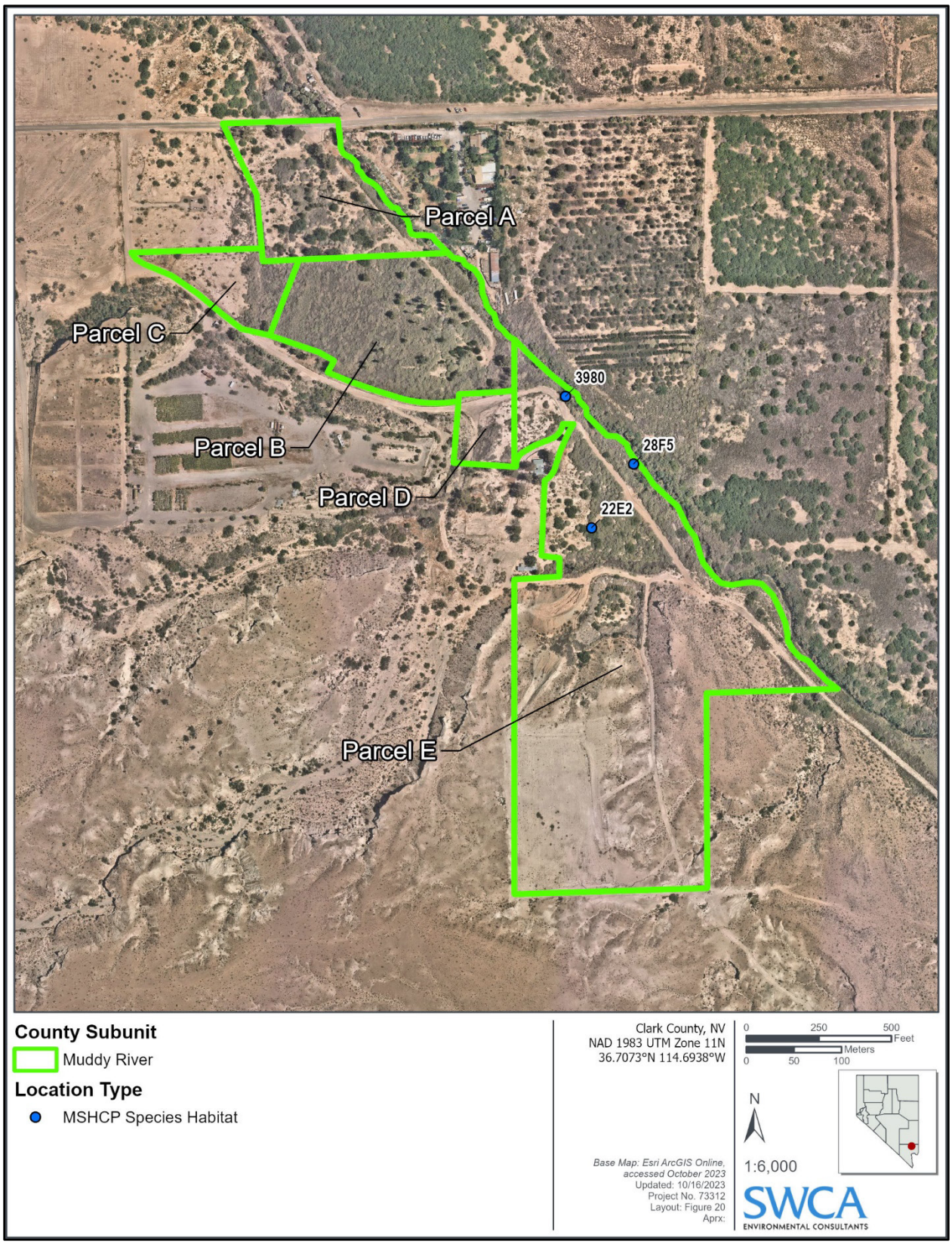

Figure 20. Datalogger locations at Muddy River.

Levels of statistical significance (P values, alpha = 0.95) were generated using Type II Wald $\chi 2$ tests (car::Anova in R). Plots were again generated using ggplot2 in R.

Conditions at the 10 unoccupied SWFL habitat locations were compared to those at SWFL nests and at MSHCP species habitat. Based on the results of the statistical analyses, the two parameters selected by SWCA to differentiate between these habitats were daily maximum temperature and daily mean humidity. The interquartile range (IQR) was used to describe the mean tendency of the temperature and humidity data collected from SWFL nests and MSHCP species habitat in June and in July (i.e., the months in which southwestern willow flycatcher select sites for nesting). The distribution of the microclimate data collected by the unoccupied SWFL habitat dataloggers was compared to these IQRs to visually evaluate similarity (horizontal boxplots generated using ggplot2 in R).

Finally, the similarity of individual unoccupied SWFL habitats to SWFL nests was characterized using a ranking metric. Ranking the unoccupied SWFL habitats for their similarity in microclimate to the SWFL nests was accomplished by the following:

- Calculating the difference between the median values measured at the unoccupied SWFL habitat and at the SWFL nests in June and July, with each month calculated separately. Daily maximum temperature and daily mean humidity were the parameters selected for this similarity evaluation. Statistical analysis of these two parameters showed distinction between SWFL nests and unoccupied SWFL habitat, meaning these two parameters are likely influence nest site selection by southwestern willow flycatcher.
- Normalizing the differences in value to account for differences of scale between humidity and temperature. This produced a score for each unoccupied SWFL habitat location for each month and each parameter.
- Calculating the mean among the scores for each unoccupied SWFL habitat location. There were four scores that went into this mean score—one for each parameter in each of June and July.
- Sorting the mean scores and ranking them 1 to 10. A low mean score indicated that that unoccupied SWFL habitat had high similarity to SWFL nests, so the unoccupied SWFL habitat with lowest mean score was given a rank of 1. A high mean score indicated that an unoccupied SWFL habitat had low similarity to the SWFL nests, so the unoccupied SWFL habitat with the highest mean score was given a rank of 10. The rank indicates similarity to SWFL nests 1 (highest) to 10 (lowest).

3 RESULTS AND EVIDENCE OF THE RESULTS

3.1 Objectives Completed

The objectives for this project were 1) to continue building on a baseline record of federally listed and non-listed bird species present at both the Riparian Reserve Units and the BCCE, 2) to conduct surveys for southwestern willow flycatcher at the Mesquite West and Mormon Mesa sites, 3) to monitor all southwestern willow flycatcher nests located at the Mesquite West and Mormon Mesa sites and record all successes and failures, 4) to record instances of parasitism by brown-headed cowbirds, 5) to conduct brown-headed cowbird control at Mesquite West throughout the southwestern willow flycatcher breeding season, and 6) to use microclimate dataloggers to identify potential habitat that does not meet the needs for southwestern willow flycatcher reproduction in what seems like otherwise suitable habitat. All above objectives were completed in 2023, and results of the 2023 field efforts are presented here.

3.2 Survey Effort

3.2.1 Federally Listed Bird Surveys

The five rounds of southwestern willow flycatcher surveys were completed by SWCA biologists Steve Dougill, Sarah Nichols, Justin Streit, Lauren Strong, and Mike Swink between May 15 and July 17, 2023 (Table 1). Each round of southwestern willow flycatcher surveys required from six to seven observer-mornings. In 2023, SWCA surveyed a total of 55.8 ha (137.8 acres) for southwestern willow flycatcher (see Figures 3–8), and surveys required 107.6 survey-hours (see Table 1). Southwestern willow flycatcher surveys concluded by 10:30 a.m. PDT. Descriptions of and rationale for areas excluded from surveys in 2023 are included in Section 4.0.

The four rounds of yellow-billed cuckoo surveys were completed by M. Swink, J. Streit, and S. Nichols between June 21 and August 8, 2023 (Table 2). Each yellow-billed cuckoo survey round required five or six observer-mornings. In 2023, SWCA surveyed a total of 49.1 ha (121.4 acres) for yellow-billed cuckoo across all subunits (see Figures 3–8), and surveys required 61.9 survey-hours (see Table 2). Yellow-billed cuckoo surveys concluded by 11:10 a.m. PDT or when the temperature reached 40ºC (104°F), whichever occurred first. Descriptions of and rationale for areas excluded from surveys in 2023 are included in Section 4.0.

3.2.2 Point-Count Surveys

The three rounds of point-count surveys were completed at the Riparian Reserve Units by S. Dougill, J. Streit, and M. Swink between May 3 and June 24, 2023 (Table 3). Each round of point counts required four or five mornings to cover the Riparian Reserve Units. Weather conditions were favorable during all three survey rounds, with light drizzle or rain reported during just three point-count surveys and wind speeds ranging from 0 to 18.0 km (0 to 11.2 miles) per hour.

S. Dougill, M. Swink, and S. Nichols completed three rounds of point-count surveys within the BCCE between May 1 and May 25, 2023 (Table 4). Each round of point counts at the BCCE required three observer-mornings. Weather conditions were favorable during all three survey rounds, with no precipitation and wind speeds ranging from 0 to 18.0 km (0 to 11.2 miles) per hour.

3.3 Findings

3.3.1 Federally Listed Bird Surveys and Monitoring

3.3.1.1 SOUTHWESTERN WILLOW FLYCATCHER

Adult willow flycatchers detected for at least 7 days at a particular study area were considered to be residents at that study area and were determined to be of the southwestern subspecies. Additionally, adults detected between June 24 and July 17 were also considered to be of the southwestern subspecies, regardless of detection duration.

In total, 29 adult willow flycatchers were detected during survey and monitoring activities at the Riparian Reserve Units in 2023 (Table 5).

Table 1. Survey Dates and Effort for Southwestern Willow Flycatcher Surveys, 2023

Subunit	Mesquite		Bunkerville			Riverside	Mormon Mesa	Mormon Mesa South	Muddy River
Parcel(s)	**West West**	**1-A**	**2-A through 2-G**	**2-I and 2-J**	**2-K through 2-M**	**3-A and 3-B**	**5-A**	**6-A and 6-B**	**A through H**
First survey	May 17	May 15	May 25	May 26	May 26	May 21	May 28	May 16	May 21
Second survey	June 6	June 8	June 7	June 7	June 7	June 1	June 5	June 11	June 1
Third survey	June 14	June 15	June 14	June 13	June 13	June 21	June 13	June 29	June 21
Fourth survey	June 26	June 26	June 22	June 27	June 27	June 27	July 7	July 12	June 27
Fifth survey	July 3	July 3	July 1	July 9	July 9	July 4	July 15	July 17	July 4
Area surveyed (acres)	28.1	9.9	17.0	13.9	5.3	8.9	10.8	35.4	8.5
Total survey hours	**14.1**	**9.5**	**20.6**	**13.8**	**9.2**	**11.6**	**9.4**	**11.6**	**7.8**

Table 2. Survey Dates and Effort for Yellow-Billed Cuckoo Surveys, 2023

Subunit	Mesquite	Bunkerville			Riverside	Mormon Mesa	Mormon Mesa South	Muddy River
Parcel(s)	**1-A**	**2-A through 2-G**	**2-I and 2-J**	**2-K through 2-M**	**3-A and 3-B**	**5-A**	**6-A and 6-B**	**A through H**
First Survey	June 25	June 25	June 28	June 28	June 23	June 21	June 29	June 23
Second Survey	July 10	July 10	July 13	July 13	July 5	July 3	July 12	July 5
Third Survey	July 23	July 22	July 26	July 26	July 17	July 15	July 24	July 17
Fourth Survey	August 4	August 4	August 8	August 8	August 1	July 29	August 6	August 1
Area surveyed (acres)	9.9	17.0	13.9	5.3	8.9	22.5	35.4	8.5
Total Survey hours	**4.1**	**12.9**	**9.0**	**6.7**	**10.3**	**5.3**	**8.9**	**4.7**

Table 3. Survey Dates for Point-Count Surveys at the Riparian Reserve Units, 2023

Subunit	Mesquite	Bunkerville			Riverside	Mormon Mesa	Mormon Mesa South	Muddy River
Parcel(s)	**1-A**	**2-A through 2-G**	**2-I and 2-J**	**2-K through 2-M**	**3-A and 3-B**	**5-A**	**6-A and 6-B**	**A through H**
First survey	May 3	May 5	May 3, 5	May 3, 4	May 4	May 4	May 13	May 4
Second survey	May 15	May 14	May 14, 15	May 14, 15	May 15	May 13	May 28	May 16
Third survey	June 18	June 18	June 22	June 22	June 22	June 21	June 21	June 24

Table 4. Survey Dates for Point-Count Surveys at the BCCE, 2023

Survey Round	Dates
First	May 1, 2
Second	May 10, 11, 12
Third	May 22, 24, 25

Table 5. Details of Southwestern Willow Flycatchers and Willow Flycatchers Detected at Monitored Study Areas, 2023

Study Area[a]	Parcel	Date Banded[b]	Federal Band No.[b]	Color Combination[c]	Age[d]	Sex[e]	Territory or Location[f]	Observation Status[g,h]
MESQ	1-A[i]	July 1, 2021	2660-23379	EY:RKR(M)	4Y	M	T01	RS; detected May 9 – July 2
		July 19, 2022	2940-35234	Xs:YB(M)	A3Y	F	02	RS
		July 13, 2021	2660-23396	RYR(M):EY	3Y	M	02	RS
		June 27, 2023	1710-58932	GL(M):GN	L	U	02	N
		June 27, 2023	2590-59220	KMK(M):Vs	L	U	02	N
		June 27, 2023	2940-35281	Xs:GMG(M)	L	U	02	N
		August 3, 2023	1710-58955	GN:WGW(M)	L	U	02	N; not confirmed as fledged
		August 3, 2023	2940-35297	Xs:KG(M)	L	U	02	N; not confirmed as fledged
		INA	INA	undetermined	AHY	F	03	
		INA	INA	banded	AHY	M	03	RS
		N/A	N/A	UB:UB	AHY	F	04	RS
		June 1, 2022	2590-53195	Xs:BB(M)	A3Y	M	04	R July 2

Study Area[a]	Parcel	Date Banded[b]	Federal Band No.[b]	Color Combination[c]	Age[d]	Sex[e]	Territory or Location[f]	Observation Status[g,h]
		July 11, 2023	1710-58937	YGY(M):GN	L	U	04	N
		July 11, 2023	1710-58936	GN:DWD(M)	L	U	04	N
		July 11, 2023	2940-35283	Xs:GL(M)	L	U	04	N
		July 2, 2023	1710-58933	GN:YWY(M)	AHY	F	05	N
		July 22, 2023	2940-35289	RR(M):Xs	AHY	M	05	N
		June 9, 2023	1710-58929	GN:YK(M)	AHY	M	T06	N; detected May 17 – June 28
		August 14, 2021	2590-53196	WRW(M):XX	3Y	F	07	RS
		May 30, 2023	2940-35272	Xs:KV(M)	AHY	M	07	N
		July 11, 2023	1710-58938	GN:YLY(M)	L	U	07	N
		August 11, 2023	1710-58958	GN:GB(M)	L	U	07	N
		June 27, 2019	2660-23228	MY(M):VI	5Y	M	T08	RS; detected May 17 – July 18
		June 13, 2022	2590-53199	Xs:KWK(M)	3Y	M	T09	RS; detected May 17 – July 20
		June 25, 2022	2940-35207	Xs:BMB(M)	A3Y	F	10	RS
		May 27, 2020	2660-23165	MG(M):VI	A5Y	M	10	RS
		July 21, 2023	2940-35288	Xs:WVW(M)	L	U	10	N
		July 21, 2023	1710-58945	GN:KM(M)	L	U	10	N
		July 13, 2021	2660-23395	WGW(M):EY	4Y	F	11	RS
		INA	INA	undetermined	AHY	M	11	
		INA	INA	undetermined	AHY	U	F12	detected May 31
		N/A	N/A	UB:UB	AHY	F	13	RS
		July 20, 2021	2660-23399	KBK(M):EY	A4Y	M	13	RS
		August 7, 2023	1710-58957	GN:GY(M)	L	U	13	N
		INA	INA	banded	AHY	U	F14	RS; detected June 14
		INA	INA	undetermined	AHY	M	F15	detected June 15
		June 26, 2023	1710-58964	GN:DM(M)	SY	M	T16	N; detected June 24 – July 23
		INA	INA	banded	AHY	U	F17	RS; detected July 14
		N/A	N/A	UB:UB	AHY	M	F18	detected August 11

Study Area[a]	Parcel	Date Banded[b]	Federal Band No.[b]	Color Combination[c]	Age[d]	Sex[e]	Territory or Location[f]	Observation Status[g,h]
MOME	5-A	July 3, 2023	2590-59221	Vs:WRW	SY	F	01	N
		N/A	N/A	UB:UB	AHY	M	01	RS
		INA	INA	undetermined	AHY	U	F02	detected June 5

[a] MESQ = Mesquite and MOME = Mormon Mesa.

[b] INA = information not available, and N/A = not applicable.

[d] Color-band codes: B = light blue, D = dark blue, EY = electric yellow federal band, G = green, GN = green federal band, K = black, L = lavender, M = mulberry, (M) = metal pinstriped band, R = red, UB = unbanded, V = violet, Vs = violet federal band, W = white, Xs = standard silver federal band, and Y = yellow. Color combinations are read as the bird's left leg and right leg, top to bottom; two or three letters designate every band; color-band designations for left and right legs are separated with a colon. Combinations applied in 2023 could represent a re-use of combinations used in earlier years; standard silver federal bands applied prior to 2022 were reported as XX and violet federal bands applied prior to 2023 were reported as VI.

[d] Age in 2023: L = nestling, SY = 2 years, AHY = 2 years or older, 3Y = 3 years, A3Y = 3 years or older, 4Y = 4 years, A4Y = 4 years or older, 5Y = 5 years, and A5Y = 5 years or older.

[e] Sex codes: F = female, M = male, and U = unknown.

[f] Territory or location code: Numbers indicate unique individual, pair, or nest locations; a number without an alpha prefix indicates a flycatcher pair; F = individual detected for less than 7 days; and T = territorial individual detected for at least 7 days.

[g] Observation status codes: N = new capture, R = recapture followed by date captured, and RS = resight.

[h] Dates shown aid in distinguishing floaters (F) from territorial residents (T). All pairs were residents; no dates of detection are shown for pairs.

[i] Includes Mesquite West West.

Of the 29 adults, 26 were detected at Mesquite West and three were detected at Mormon Mesa Parcel 5-A. Of the 26 adults detected at Mesquite West, 21 were residents of the southwestern subspecies that were present for at least 7 days. Individuals present for at least 7 days were considered to have occupied territories, whereas individuals present for less than 7 days were assumed not to have occupied territories and were considered non-residents (herein referred to as floaters). In 2023, each of the five floaters at Mesquite West was detected for only 1 day. One floater was considered to be of the southwestern subspecies based on the date of detection being outside known migration windows (i.e., after June 24 and on or before July 17). This individual was detected on July 14 and was also confirmed to be banded, thereby further confirming the southwestern subspecies identification. One individual detected on June 14 was confirmed to be of the southwestern subspecies due to being previously color banded. Of the three remaining floaters detected at Mesquite West, one was detected during the third round of surveys on June 15, and two were detected during monitoring activities on May 31 and August 11. One of these individuals was determined to be unbanded, while band status for the other two remained undetermined. These three individuals were believed to be migrants based on their dates of detection within known migration windows and lack of territorial behavior (e.g., engaging in lengthy primary song) or subsequent detections. Of the three adults detected at Mormon Mesa Parcel 5-A, two were residents of the southwestern subspecies that were present for at least 7 days and occupied one breeding territory, and one was a floater that was present for less than 7 days and did not occupy a territory. The floater was detected during the second round of surveys at Mormon Mesa Parcel 5-A on May 31. Band status could not be determined, and this individual was considered a northbound migrant based on date of detection.

Twenty-five of the 29 adult willow flycatchers detected in 2023 were determined to be individuals of the southwestern subspecies either because they were present for at least 7 days and occupied territories, or because they were resighted as being banded. Of these 25 southwestern willow flycatchers, 20 (80%) were known to be banded. Six of the 20 banded adults were banded in 2023, and 14 were returning adults that had been banded in previous years. Of the 14 previously banded birds, 11 were individually identified by band combination while three could not be identified to individual. Of the 11 birds that had been previously detected as adults, all returned to the Mesquite study area where they had been most recently detected. Of the four floaters that could not be assigned to the southwestern subspecies, one was unbanded, and the band status for three individuals could not be determined.

3.3.1.1.1 Mesquite West

Biologists spent 116.8 observer-hours on territory and nest monitoring at Mesquite West in 2023; activities included determining residency status, observing resident southwestern willow flycatchers, monitoring nests, and banding adults and nestlings. The 26 adults documented at Mesquite West in 2023 comprised eight pairs, five territorial males, and five floaters (see Table 5). Two of the floaters were determined to be of the southwestern subspecies due to having been previously color banded.

Five new adults were color banded (see Table 5). One adult banded in a previous year was recaptured. Ten additional adults were identified to individual via resighting. Three adults were determined to be banded, but their color combinations could not be confirmed. Three adults remained unbanded; band status could not be determined for the remaining four adults. Thirteen nestling southwestern willow flycatchers were newly banded in 2023 (see Table 5).

Nests were confirmed for seven of the eight pairs documented in 2023. Thirteen confirmed nesting attempts were documented (Appendix A: Figure A-1). Of the 13 nesting attempts that were documented at Mesquite West in 2023, all were known to contain at least one southwestern willow flycatcher egg and were used in calculating nest success and productivity. Six (46%) of these 13 nests were successful and fledged young, and seven (54%) failed (Table 6; Figure 21).

Table 6. Summary of Southwestern Willow Flycatcher Nest Monitoring Results at All Study Areas, 2019–2023

Study Area[a]	Year	Pairs	Nests with 1+ WE[b]	Successful Nests[c]	Failed Nests[c]	Nests with Unknown Fate	Nests with 1+ WE[b] and Known Parasitism Status	Parasitized Nests[d]	Young Fledged
MESQ	2019	6	9	4 (44)	4 (44)	1 (11)	8	4 (50)	5
	2020[e]	4	5	0	5 (100)	0	5	2 (40)	0
	2021	3	6	2 (33)	4 (67)	0	6	3 (50)	3
	2022	7	9	7 (78)	1 (11)	1 (11)	9	2 (22)	13
	2023	8	13	6 (46)	7 (54)	0	12	1 (8)	11
	Total	**28**	**42**	**19 (45)**	**21 (50)**	**2 (5)**	**40**	**12 (30)**	**32**
MOME	2019	0	0	0	0	0	0	0	0
	2020	2	1	1 (100)	0	0	1	0	1
	2021	0	0	0	0	0	0	0	0
	2022	0	0	0	0	0	0	0	0
	2023	1	1	0	1 (100)	0	1	1 (100)	0
	Total	**3**	**2**	**1 (50)**	**1 (50)**	**0**	**2**	**1 (50)**	**1**
All	2019	6	9	4 (44)	4 (44)	1 (11)	8	4 (50)	5
	2020	6	6	1 (17)	5 (83)	0	6	2 (33)	1
	2021	3	6	2 (33)	4 (67)	0	6	3 (50)	3
	2022	7	9	7 (78)	1 (11)	1 (11)	9	2 (22)	13
	2023	9	13	6 (46)	7 (54)	0	13	2 (15)	11
Overall total		31	44	20 (45)	22 (50)	2 (5)	42	13 (31)	33

[a] MESQ= Mesquite and MOME = Mormon Mesa.

[b] WE = willow flycatcher egg.

[c] Only nests with at least one flycatcher egg were used in tallies and percentage calculations. Percentages are given in parentheses.

[d] Parasitized nests include all nests that contained at least one flycatcher egg and one brown-headed cowbird egg regardless of nest fate. Percentages in parentheses include only nests with at least one flycatcher egg and for which parasitism status could be determined.

[e] Data presented are for Mesquite Parcel 1-A only; no monitoring was conducted at Mesquite West West.

Figure 21. Left: Parasitized southwestern willow flycatcher nest with one brown-headed cowbird egg at nest 01A at Mormon Mesa Parcel 5-A. Right: Southwestern willow flycatcher fledgling from nest 07B at Mesquite West West.

Nesting attempts were located for seven of eight female southwestern willow flycatchers. All seven females for which nests were located were known to have produced at least one egg. Two females had one nesting attempt, four had two nesting attempts, and one had three nesting attempts. In total, 11 fledglings were produced from 13 nests. Productivity at Mesquite West was 0.85 young per nest in 2023, and fecundity was 1.38 young produced per female (Table 7).

Table 7. Southwestern Willow Flycatcher Nest Productivity and Fecundity at Mesquite West, 2019–2023

Year	No. Young Fledged	No. Nests with Known Outcome	Productivity Mean (SE)[a]	No. Females with Known Outcome	Fecundity Mean (SE)[b]
2019	5[c]	8	0.63 (0.26)	5[d]	0.80 (0.58)
2020	0	5	0	4	0
2021	3	6	0.50 (0.34)	3	1.00 (0.58)
2022	13[e]	8	1.63 (0.26)	6[d]	1.83 (0.54)
2023	11	13	0.85 (0.32)	8	1.38 (0.46)
Total	**32**	**40**	**0.80 (0.15)**	**26[f]**	**1.12 (0.24)**

[a] Productivity calculations (number of young produced per nest) include nests that contained flycatcher eggs and had a known outcome. SE = standard error.

[b] Fecundity calculations (number of young produced per female) include all females for which all nest outcomes were known. SE = standard error.

[c] One fledgling associated with a female for which the fate of her subsequent nesting attempt is unknown is not included in the fecundity calculation.

[d] One female that had one successful nest and one nest of unknown outcome is not included.

[e] Two fledglings associated with a female for which the fate of her subsequent nesting attempt is unknown are not included in the fecundity calculation.

[f] Two females that had one successful nest and one nest of unknown outcome are not included.

Seven nest failures were documented at Mesquite West in 2023. Depredation was the cause of failure at five nests (71%), one nest (14%) was deserted, and the cause of failure for one nest (14%) was unknown (Table 8).

Table 8. Summary of Causes of Southwestern Willow Flycatcher Nest Failure at Mesquite West, 2023

Total No. of Nests	All Failed Nests	Depredated	Deserted	Unknown
13	7	5 (71%)	1 (14%)	1 (14%)

Note: All nesting attempts (those with and without southwestern willow flycatcher eggs) are included. Percentage of failed nests is shown in parentheses for each cause of failure. Depredated = nest empty or destroyed 2 days or more before anticipated fledge date. Deserted = deserted with egg(s) or young.

Twelve of the 13 nests monitored in 2023 had at least one southwestern willow flycatcher egg and a known parasitism status (see Table 6). The nest with unknown parasitism status was assumed to have failed during the laying stage; the female was observed building the nest on one visit, and the nest was completely gone on the next visit 10 days later. The nest was located above flowing water, and no evidence was found of eggshell fragments beneath the nest. Therefore, parasitism status could not be determined. One (8%) of 12 nests with southwestern willow flycatcher eggs and known parasitism status was brood parasitized by brown-headed cowbirds (Table 9). Nest 13A in Parcel 1-A contained one southwestern willow flycatcher egg and one brown-headed cowbird egg when the nest was located. Biologists replaced the brown-headed cowbird egg with a fake egg 4 days after the nest was found. The female incubated this nest for at least 9 days after the fake brown-headed cowbird egg was placed, and at some point the fake brown-headed cowbird egg disappeared. On the next visit, two southwestern willow flycatcher eggs were observed in the nest, and it was determined that the first nest failed due to unknown causes, and the female had laid a second clutch in the same nest structure.

Table 9. Fates of Southwestern Willow Flycatcher Nests Parasitized by Brown-headed Cowbirds at Mesquite and Mormon Mesa, 2023

Study Area[a]	Nest ID	Outcome[b]
MESQ	13A	1WE, 1CE in nest; CE replaced with fake egg. WE incubated for at least 9 days following fake egg introduction. Nest failed due to unknown causes.
MOME	01A	3WE in nest one visit; 2WE in nest on following visit. All WE gone and 1CE in nest on next visit. Nest failed due to parasitism.

[a] MESQ = Mesquite and MOME = Mormon Mesa.

[b] WE = flycatcher egg(s) and CE = brown-headed cowbird egg.

3.3.1.1.2 Mormon Mesa

Biologists spent 12.7 observer-hours territory monitoring at Mormon Mesa Parcel 5-A in 2023; monitoring activities included determining residency status, observing resident southwestern willow flycatchers, monitoring one flycatcher nest, and banding one adult. Three adult southwestern willow flycatchers were documented at Mormon Mesa in 2023. The three adults comprised one breeding pair and one floater.

One nesting attempt was documented just north of Mormon Mesa Parcel 5-A in 2023 (Appendix A: Figure A-2). This nest was parasitized and failed as a result of the parasitism event (see Table 9, see Figure 21). The nesting female was captured and banded.

3.3.1.2 YELLOW-BILLED CUCKOO

Yellow-billed cuckoo surveys across the Riparian Reserve Units in 2023 resulted in 13 yellow-billed cuckoo detections. In addition, four incidental yellow-billed cuckoo detections were recorded across Mesquite West, Bunkerville Parcels 2-K through 2-M, and Mormon Mesa Parcel 5-A. Three yellow-

billed cuckoo detections were recorded (one during surveys and two incidentally) at Mesquite Parcel 1-A (Appendix A: Figure A-3), one detection was recorded during surveys at Bunkerville Parcels 2-A through 2-G Appendix A: Figure A-4), and two detections were recorded (one during surveys and one incidentally) at Bunkerville Parcels 2-K through 2-M (Appendix A: Figure A-5); all detections at each of these sets of parcels occurred within a single survey period; therefore, none of these areas are assumed to be breeding territories. No yellow-billed cuckoo detections were recorded at Bunkerville Parcels 2-I and 2-J in 2023. One yellow-billed cuckoo detection was recorded during surveys during each of two survey periods at Riverside Parcels 3-A and 3-B (Appendix A: Figure A-6). The proximity and timing of these detections (at least two detections within 300 m [984.3 feet] of each other and across two survey periods) qualify the detection area at the Riverside Riparian Reserve Unit as a possible breeding territory. Six yellow-billed cuckoo detections were recorded (five during surveys and one incidentally) at Mormon Mesa Parcel 5-A (Appendix A: Figure A-7); one detection was recorded during each of the first and third survey periods, and two detections were detected during each of the second and fourth survey periods. No evidence of courtship was recorded; however, due to the proximity and timing of detections (at least three detections within 300 m [984.3 feet] of each other and during at least three survey periods), the area qualifies as a probable breeding territory (Halterman et al. 2016). No yellow-billed cuckoo detections were recorded at the Mormon Mesa South Subunit in 2023. Three detections were recorded during surveys across two survey periods at Muddy River Parcels A through E (Appendix A: Figure A-8); the proximity and timing of these detections qualify the detection area at the Muddy River Subunit as a possible breeding territory.

3.3.2 Brown-headed Cowbird Control

Brown-headed cowbird netting was conducted over a period of 12 weeks, beginning May 9 and ending July 26 (Table 10). Netting occurred on 15 mornings, with a total of 33 separate net set-ups totaling 26.3 net-hours. No individual netting attempt lasted more than 1.1 hours. Two to three nets were set up each morning, beginning at first light and ending by 10:00 am PDT. In total, 10 brown-headed cowbirds were captured: six males and four females. No males were recaptured. Biologists used a small mammal guillotine to decapitate the four female brown-headed cowbirds immediately following extraction from the net. As detailed in Section 3.3.1, one brown-headed cowbird egg was replaced with a fake egg (see Table 9).

3.3.3 Point-Count Surveys

In total, 79 avian species were recorded across all the County's properties during 2023 point-count surveys, and MSHCP-covered species were observed at each property. Two additional species were incidentally detected during federally listed bird surveys but were not detected during point counts.

3.3.3.1 RIPARIAN RESERVE UNITS

3.3.3.1.1 MSHCP Species

Of the eight avian species covered by the MSHCP, six were recorded during the 2023 point-count surveys: American peregrine falcon, Arizona Bell's vireo, blue grosbeak, phainopepla, southwestern willow flycatcher, and yellow-billed cuckoo. The two remaining MSHCP-covered avian species were detected incidentally at the Riparian Reserve Units. A summer tanager was detected on July 15 at Mormon Mesa Parcel 5-A, and two vermilion flycatchers were detected: one on July 10 at Bunkerville Parcel 2-B and one on August 1 at Riverside Parcel 3-A (Table 11).

Table 10. Number of Brown-headed Cowbirds Netted by Date at Mesquite West, 2023

Sex	May 9	May 12	May 17	May 20	May 24	May 27	May 30	Jun 9	Jun 17	Jun 24	Jun 30	Jul 6	Jul 14	Jul 22	Jul 26	Total
Male	0	1	0	0	2	0	1	0	1	0	0	1	0	0	0	6
Female	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	4
Total	**1**	**1**	**0**	**1**	**2**	**0**	**1**	**0**	**2**	**0**	**0**	**1**	**0**	**1**	**0**	**10**

Table 11. Number of Detections and Breeding Codes for MSHCP Avian Species Recorded at the Riparian Reserve Units During Point-Count Surveys, 2023

Subunit	Mesquite	Bunkerville		Riverside	Mormon Mesa	Mormon Mesa South	Muddy River
Parcel(s)	**1-A**	**2-A through 2-G**	**2-I through 2-M**	**3-A and 3-B**	**5-A**	**6-A and 6-B**	**A–H**
American peregrine falcon	–	X	–	–	–	–	1
Arizona Bell's vireo	1 (PO)	–	–	6 (CO)*	I (CO)*	1 (PO)	1 (PO)
Blue grosbeak	I	1 (PO)	4 (PO)	I	–	3 (PO)	4 (PO)
Crissal thrasher	–	1 (PO)	X	1 (CO)*	–	X	2 (CO)*
Loggerhead shrike	–	–	–	I	I	–	–
Phainopepla	–	–	–	1	–	–	5
Summer tanager	–	–	–	–	I	–	–
Southwestern willow flycatcher	1 (CO)*	–	–	–	–	–	–
Vermilion flycatcher	–	I	–	I	–	–	–
Yellow-billed cuckoo	–	–	–	–	1	–	–

Note: X = species recorded at that unit during point-counts but never within 100 m (328 feet) of a point-count location; CO = Breeding confirmed—adult observed carrying nesting material, adult at a nest, or a fledgling observed; PO = breeding possible—individual(s) singing in appropriate habitat at that unit during the breeding season. I = species recorded incidentally during surveys or monitoring for federally listed birds but not during point-count surveys.

* Breeding was confirmed for this species during surveys or monitoring for federally listed birds but not during point-count surveys.

In addition to the eight covered bird species, the MSHCP also identifies seven evaluation bird species for which future viability is a concern and that may be considered for inclusion in subsequent amendments to the MSHCP. Crissal thrasher (*Toxostoma crissale*) was recorded at parcels in the Bunkerville, Riverside, Mormon Mesa South, and Muddy River Subunits. Loggerhead shrike (*Lanius ludovicianus*) was detected incidentally at the Riverside and Mormon Mesa Subunits (see Table 11).

For each species, the number of recorded individuals is listed for each set of connected parcels. To standardize the data and account for species that may be detected at greater distances than others (e.g., crissal thrasher), numbers reported in Table 11 only include birds detected within 100 m (328 feet) of a point-count location (GBBO 2003; Ralph et al. 1995).

SWCA documented multiple southwestern willow flycatcher nesting attempts at Mesquite West and one nesting attempt at Mormon Mesa Parcel 5-A in 2023. Arizona Bell's vireo fledglings were observed at Riverside Parcel 3-A, and active nests were located at Mormon Mesa Parcel 5-A and Riverside Parcel 3-B, confirming breeding for this species. Additionally, one Crissal thrasher nest was located at Muddy River Parcel E, and fledglings were observed at Riverside Parcel 3-A, confirming breeding of crissal thrasher at those sites. Arizona Bell's vireo, blue grosbeak, and crissal thrasher were suspected of breeding at various other Riparian Reserve Units (refer to breeding codes in Table 11; note that a species without a breeding code does not indicate that the species was not breeding in a particular subunit or set of parcels, but only that no evidence of such was recorded). Breeding could not be confirmed in 2023 for any of the other MSHCP species.

3.3.3.1.2 Non-MSHCP-listed Species

During the three rounds of point-count surveys in 2023, biologists recorded 62 non-MSHCP avian species across all the Riparian Reserve Units (Table 12). To account for species that may be detected at greater distances than others, numbers reported in Table 12 only include birds detected within 100 m (328 feet) of a point-count location (GBBO 2003; Ralph et al. 1995).

Of the 62 non-MSHCP species, eight were recorded at each of the six subunits: Abert's towhee (*Pipilo aberti*), brown-headed cowbird, Gambel's quail (*Callipepla gambelii*), Lucy's warbler (*Leiothlypis luciae*), mourning dove (*Zenaida macroura*), northern rough-winged swallow (*Stelgidopteryx serripennis*), verdin (*Auriparus flaviceps*), and yellow-breasted chat (*Icteria virens*). Although some species (e.g., western tanager [*Piranga ludoviciana*], Wilson's warbler [*Cardellina pusilla*], and yellow-rumped warbler [*Setophaga coronata*]) were likely migrating through the area on their way to breeding grounds farther north or at higher elevations, most of the species recorded during point-count surveys are known to breed in the Mojave Desert. While breeding could not be confirmed for most of the species recorded at the Riparian Reserve Units, it is assumed that many may have bred or attempted to breed in the Riparian Reserve Units in 2023.

Breeding was confirmed for Abert's towhee, brown-headed cowbird, common raven (*Corvus corax*), Gambel's quail, house sparrow (*Passer domesticus*), Lucy's warbler, mourning dove, verdin, and yellow-breasted chat, for which biologists recorded the observation of a fledgling, an adult carrying food, an adult at a nest, or eggs in a nest. Additionally, 22 other species were recorded singing or performing territorial displays, indicating that breeding for those species was possible within the Riparian Reserve Units (though some species may also exhibit either of these behaviors during migration).

Table 12. Number of Detections and Breeding Codes for Non-MSHCP Avian Species Recorded at the Riparian Reserve Subunits During Point-Count Surveys, 2023

Common Name	Scientific Name	Clark County Riparian Reserve Subunits					
		Mesquite	Bunkerville	Riverside	Mormon Mesa	Mormon Mesa South	Muddy River
Red-winged blackbird	*Agelaius phoeniceus*	1 (PO)	32 (PO)	4 (PO)	–	4 (PO)	–
Black-throated sparrow	*Amphispiza bilineata*	–	–	1	–	–	–
Mallard	*Anas platyrhynchos*	–	X	–	–	–	X
Woodhouse's scrub-jay	*Aphelocoma woodhouseii*	–	X	–	–	–	–
Black-chinned hummingbird	*Archilochus alexandri*	1	6 (PO)	–	–	–	–
Great blue heron	*Ardea herodias*	X	X	X	X	–	–
Verdin	*Auriparus flaviceps*	3 (PO)	22 (PO)	10 (CO)*	1	4	6
Canada goose	*Branta canadensis*	X	X	8	–	X	–
Red-tailed hawk	*Buteo jamaicensis*	–	1	1	–	–	–
Green heron	*Butorides virescens*	–	1	–	–	–	–
Gambel's quail	*Callipepla gambelii*	10 (CO)*	26 (CO)*	X	1	X	36 (PO)
Anna's hummingbird	*Calypte anna*	1 (PO)	–	–	–	–	1
Costa's hummingbird	*Calypte costae*	–	2	–	–	–	–
Wilson's warbler	*Cardellina pusilla*	–	3	–	–	–	1
Turkey vulture	*Cathartes aura*	–	X	1	X	–	X
Killdeer	*Charadrius vociferus*	X	9	X	X	2	–
Rock pigeon	*Columba livia*	–	X	–	–	–	X
Western wood-pewee	*Contopus sordidulus*	–	1	–	–	–	–
Common raven	*Corvus corax*	X	X	8 (CO)	X	–	X
Ladder-backed woodpecker	*Dryobates scalaris*	2 (PO)	4 (PO)	X	2	–	1
American kestrel	*Falco sparverius*	–	X	–	–	–	–
Greater roadrunner	*Geococcyx californianus*	–	X	1	–	–	X
Common yellowthroat	*Geothlypis trichas*	3 (PO)	19 (PO)	–	X	4 (PO)	–
House finch	*Haemorhous mexicanus*	–	7 (PO)	X	1	2	11 (PO)
Barn swallow	*Hirundo rustica*	–	1	2	–	–	–

Common Name	Scientific Name	Clark County Riparian Reserve Subunits					
		Mesquite	Bunkerville	Riverside	Mormon Mesa	Mormon Mesa South	Muddy River
Yellow-breasted chat	*Icteria virens*	17 (CO)*	13 (PO)	2 (PO)	6 (PO)	7 (PO)	4 (PO)
Bullock's oriole	*Icterus bullockii*	–	X	–	–	–	2 (PO)
Hooded oriole	*Icterus cucullatus*	–	–	–	–	–	3
Least bittern	*Ixobrychus exilis*	–	–	–	–	1	–
Orange-crowned warbler	*Leiothlypis celata*	–	1	–	–	–	–
Lucy's warbler	*Leiothlypis luciae*	10 (PO)	48 (CO)	10 (PO)	5 (PO)	2	13 (PO)
Song sparrow	*Melospiza melodia*	13 (PO)	2 (PO)	–	4 (PO)	–	1 (PO)
Northern mockingbird	*Mimus polyglottos*	–	6 (PO)	–	–	–	1 (PO)
Brown-headed cowbird	*Molothrus ater*	7 (CO)*	24 (PO)	3	2 (PO)	9 (PO)	4 (PO)
Ash-throated flycatcher	*Myiarchus cinerascens*	1 (PO)	–	5	2	X	2 (PO)
Brown-crested flycatcher	*Myiarchus tyrannulus*	–	–	–	1 (PO)	–	–
House sparrow	*Passer domesticus*	–	–	–	–	–	35 (CO)
Lazuli bunting	*Passerina amoena*	1 (PO)	15 (PO)	3	X	–	2 (PO)
Cliff swallow	*Petrochelidon pyrrhonota*	–	4	16	1	–	–
Black-headed grosbeak	*Pheucticus melanocephalus*	–	–	–	–	–	1
Abert's towhee	*Pipilo aberti*	5 (PO)	28 (CO)*	10 (PO)	X	4 (PO)	36 (PO)
Western tanager	*Piranga ludoviciana*	–	2	–	–	–	–
White-faced ibis	*Plegadis chihi*	–	X	–	–	–	–
Blue-gray gnatcatcher	*Polioptila caerulea*	–	4 (PO)	–	–	–	–
Black-tailed gnatcatcher	*Polioptila melanura*	–	1 (PO)	–	–	–	–
Great-tailed grackle	*Quiscalus mexicanus*	X	8 (PO)	–	–	–	–
Virginia rail	*Rallus limicola*	1 (PO)	–	–	–	–	–
Bank swallow	*Riparia riparia*	–	–	–	–	4	–
Rock wren	*Salpinctes obsoletus*	–	X	5 (PO)	–	–	11 (PO)
Black phoebe	*Sayornis nigricans*	–	–	–	–	1	3 (PO)
Say's phoebe	*Sayornis saya*	–	X	–	–	–	2
Yellow-rumped warbler	*Setophaga coronata*	–	8	2	1	–	–

Common Name	Scientific Name	Clark County Riparian Reserve Subunits					
		Mesquite	Bunkerville	Riverside	Mormon Mesa	Mormon Mesa South	Muddy River
Yellow warbler	*Setophaga petechia*	7 (PO)	18 (PO)	4 (PO)	–	1	–
Lesser goldfinch	*Spinus psaltria*	3	6 (PO)	–	–	–	–
Northern rough-winged swallow	*Stelgidopteryx serripennis*	3	34	5	5	1	4
Eurasian collared-dove	*Streptopelia decaocto*	–	1 (PO)	1	–	–	13 (PO)
Violet-green swallow	*Tachycineta thalassina*	–	–	–	–	–	X
Bewick's wren	*Thryomanes bewickii*	–	1	–	1 (PO)	2 (PO)	8 (PO)
Western kingbird	*Tyrannus verticalis*	–	X	2	–	–	4
White-winged dove	*Zenaida asiatica*	–	–	–	–	–	X
Mourning dove	*Zenaida macroura*	9 (PO)	44 (CO)*	3 (PO)	3 (CO)*	7 (PO)	22 (PO)
White-crowned sparrow	*Zonotrichia leucophrys*	–	3	–	–	–	–

Note: X = species recorded at that unit during point-counts but never within 100 m (328 feet) of a point-count location; CO = Breeding confirmed—adult observed carrying nesting material, adult at a nest, or a fledgling observed; PO = breeding possible—individual(s) singing in appropriate habitat at that unit during the breeding season. I = species recorded incidentally during surveys or monitoring for federally listed birds but not during point-count surveys.

* Breeding was confirmed for this species during surveys or monitoring for federally listed birds but not during point-count surveys.

Species richness varied between the six subunits; the Bunkerville Subunit showed the highest avian species richness, with 37 species recorded, while the Mormon Mesa Subunit yielded the lowest species richness, with 18 species recorded. The five most commonly detected species across all the Riparian Reserve Units were Lucy's warbler, mourning dove, Abert's towhee, Gambel's quail, and northern rough-winged swallow.

3.3.3.2 BCCE

3.3.3.2.1 MSHCP-listed Species

None of the eight MSHCP-covered bird species were recorded during point-count surveys in the BCCE in 2023. Two evaluation bird species were recorded: loggerhead shrike and LeConte's thrasher (*Toxostoma lecontei*), each of which was recorded from one point-count location in 2023 (Table 13). Four additional LeConte's thrashers were detected incidentally. While breeding could not be confirmed for either species in 2023, LeConte's thrasher nests have been documented in the BCCE during previous survey years (SWCA 2020).

Table 13. Number of Detections and Breeding Codes for MSHCP Evaluation Species Recorded at the BCCE during Point-Count Surveys, 2023

Common Name	Scientific Name	Total Detections	Detections within 100 m	Breeding Codes
Loggerhead shrike	*Lanius ludovicianus*	1	0	–
LeConte's thrasher	*Toxostoma lecontei*	1	0	PO

3.3.3.2.2 Non-MSHCP-listed Species

SWCA biologists recorded 20 avian species not listed under the MSHCP across the BCCE point-count locations over all three rounds of point-count surveys in 2023 (Table 14). These data are presented as total detections and detections within 100 m (328 feet) of the observer to account for species with different detection probabilities and reduce bias towards species that are more conspicuous at greater distances (e.g., common raven) (GBBO 2003; Ralph et al. 1995). Of these 20 species recorded during point-count surveys, 15 were recorded within 100 m (328 feet) of a point-count location. The two most commonly detected species at the BCCE, regardless of distance from surveyor as well as within 100 m (328 feet) of a point-count location, were black-throated sparrow (*Amphispiza bilineata*) and horned lark (*Eremophila alpestris*) (see Table 14).

Although some of the species detected at the BCCE in 2023 were likely migrating through the area on their way to breeding grounds farther north or at higher elevations (e.g., dusky flycatcher [*Empidonax oberholseri*] and MacGillivray's warbler [*Geothlypis tolmiei*]), most of these species are known to breed in the Mojave Desert and may have bred or attempted to breed within the BCCE boundary in 2023. For example, horned lark was never confirmed to be breeding within the BCCE during the 2023 point-count surveys; however, this species is one of the most common breeders in Mojave Desert scrub habitats, and it undoubtedly breeds within the BCCE boundary.

Confirmation of breeding was recorded for three species not covered under the MSHCP: black-throated sparrow, common raven, and house finch (*Haemorhous mexicanus*). Nine other species were recorded singing at the BCCE, which indicates that breeding for those species was possible (though some species sing during migration) (see Table 14). Species lacking a breeding code in Table 14 may have bred within the BCCE; however, no evidence of breeding was recorded.

Table 14. Number of Detections and Breeding Codes for Non-MSHCP-listed Species Recorded at the BCCE during Point-Count Surveys, 2023

Common Name	Scientific Name	Total Detections	Detections within 100 m	Breeding Codes*
Black-throated sparrow	*Amphispiza bilineata*	61	32	CO
Red-tailed hawk	*Buteo jamaicensis*	1	0	–
Cactus wren	*Campylorhynchus brunneicapillus*	5	1	PO
Wilson's warbler	*Cardellina pusilla*	3	3	–
Turkey vulture	*Cathartes aura*	1	0	–
Lesser nighthawk	*Chordeiles acutipennis*	1	0	PO
Common raven	*Corvus corax*	17	0	CO
Western wood-pewee	*Contopus sordidulus*	1	1	–
Western flycatcher	*Empidonax difficilis*	1	1	–
Dusky flycatcher	*Empidonax oberholseri*	1	1	–
Horned lark	*Eremophila alpestris*	47	25	PO
MacGillivray's warbler	*Geothlypis tolmiei*	1	1	–
House finch	*Haemorhous mexicanus*	14	13	CO
Northern mockingbird	*Mimus polyglottos*	3	1	PO
Ash-throated flycatcher	*Myiarchus cinerascens*	27	7	PO
Green-tailed towhee	*Pipilo chlorurus*	1	1	PO
Rock wren	*Salpinctes obsoletus*	5	2	PO
Say's phoebe	*Sayornis saya*	2	1	–
Western meadowlark	*Sturnella neglecta*	1	0	PO
Mourning dove	*Zenaida macroura*	7	1	PO

***** CO = Breeding confirmed—fledgling(s) observed; PO = breeding possible—individual(s) singing in appropriate habitat during the breeding season.

3.3.4 Thermal Refugia

3.3.4.1 LITERATURE REVIEW

The threat posed by a warming climate to avian species, particularly those inhabiting hot desert environments, is widely recognized in the literature, and warming temperatures have been implicated in the decline of Mohave Desert birds (Iknayan and Beissinger 2018; Riddle et al. 2019). Passerines, which rely on panting for evaporative cooling, are particularly susceptible to heat stress in comparison to birds that use gular fluttering or subcutaneous evaporation (Smith et al. 2017). Smith et al. (2017) found that the temperatures at which there began to be a metabolic cost for thermoregulation for six Sonoran Desert songbirds ranged from 36.2ºC to 39.7ºC (97.2–103.5ºF), and the thermal limit, at which the birds could no longer regulate their body temperatures, was around 50ºC (122ºF). In addition to causing lethal heat stress, high temperatures can have sublethal effects by causing adults to forego foraging or nest attendance in favor of thermoregulation, thus affecting body mass and fitness. In a southern African study, southern pied babblers (*Turdoides bicolor*) lost body mass when the maximum diurnal temperature reached 35.5ºC (95.9 ºF), as did southern yellow-billed hornbills (*Tockus leucomelas*) when the maximum diurnal temperature reached 37.9ºC (100.2ºF) (Conradie et al. 2019). Temperatures above 33ºC (91.4ºF)

resulted in reduced nestling mass for southern fiscals (*Lanius collaris*), whereas temperatures above 35ºC (95ºF) resulted in delayed fledging (Conradie et al. 2019).

The use of thermal refugia during hot ambient conditions has been documented in numerous species, including verdin and black-tailed gnatcatcher (*Polioptila melanura*) (Wolf et al. 1996), grasshopper sparrow (*Ammodramus savannarum*) (Ruth et al. 2020), lesser prairie chicken (*Tympanuchus pallidicinctus*) (Bell et al. 2010), and phainopepla (Walsberg 1993). Southwestern willow flycatchers nesting along the Virgin and Muddy Rivers in Nevada and along the Lower Colorado River in Arizona in 2003 through 2007 placed their nests in locations that were cooler, more humid, and more thermally moderate than randomly selected non-nest locations within 5 to 10 m (16.4–32.8 feet) from the nest, which were in turn cooler, more humid, and more thermally moderate than unused locations between 50 and 200 m (164.0 and 656.2 feet) from any nest or territory center (McLeod et al. 2008). Daily mean maximum temperatures at nests in June through August ranged from approximately 35.5ºC to 41.5ºC (95.9–106.7ºF), which was approximately 2ºC (3.6ºF) and 5ºC to 6ºC (9–10.8ºF) cooler than temperatures at the within-territory and unused locations, respectively. The study design did not permit an analysis of the influence of microclimate on nest success. Maximum daily temperatures at southwestern willow flycatcher nests in central New Mexico were approximately 4ºC to 5ºC (7.2–9.0ºF) cooler than temperatures at locations within 15 m (49.2 feet) of the nest (Smith and Johnson 2009). Studies of yellow-billed cuckoos along the Lower Colorado River showed that cuckoo nest sites had lower diurnal temperatures compared to those in available habitat. In addition, successful nests were more likely to have lower mean diurnal temperatures than did failed nests, with the odds of nest success increasing 5% with each 1ºC (1.8ºF) decrease in mean diurnal temperature (Stanek et al. 2021). No studies quantifying the thermal requirements of or the thermal conditions at the nests of other MSHCP species were found.

3.3.4.2 TEMPERATURE AND HUMIDITY DATA AT THE RIPARIAN RESERVE UNITS

Dataloggers were placed near southwestern willow flycatcher nests (SWFL nests), in areas that appeared to be suitable for flycatcher nesting but where nesting has not been observed (unoccupied SWFL habitat), and in a representative variety of riparian habitats in the County's Riparian Reserve Units (MSHCP species habitat). While the exact deployment date of the individual dataloggers varied, all dataloggers were active during June, July, and August (Table 15).

Table 15. Datalogger Measurements by Habitat Category and Month, 2023

Habitat Category	Total Number of Individual Measurements by Month			
	May	June	July	August
MSHCP species habitat	3,646	26,897	32,736	15,736
SWFL nests	0	2,967	12,784	7,421
Unoccupied SWFL habitat	1,561	14,400	14,880	7,136

3.3.4.2.1 Visual Evaluation

Density plots were used to examine the distribution of the individual measurements. For temperature, these plots showed that temperatures were generally lower in June than in July or August and that temperatures at the SWFL nests were generally cooler than in the other two habitat types (Figure 22). The temperature data had a bimodal distribution (i.e., two peaks), reflecting daytime and nighttime temperature fluctuations, with the daytime temperatures varying more greatly among habitat types.

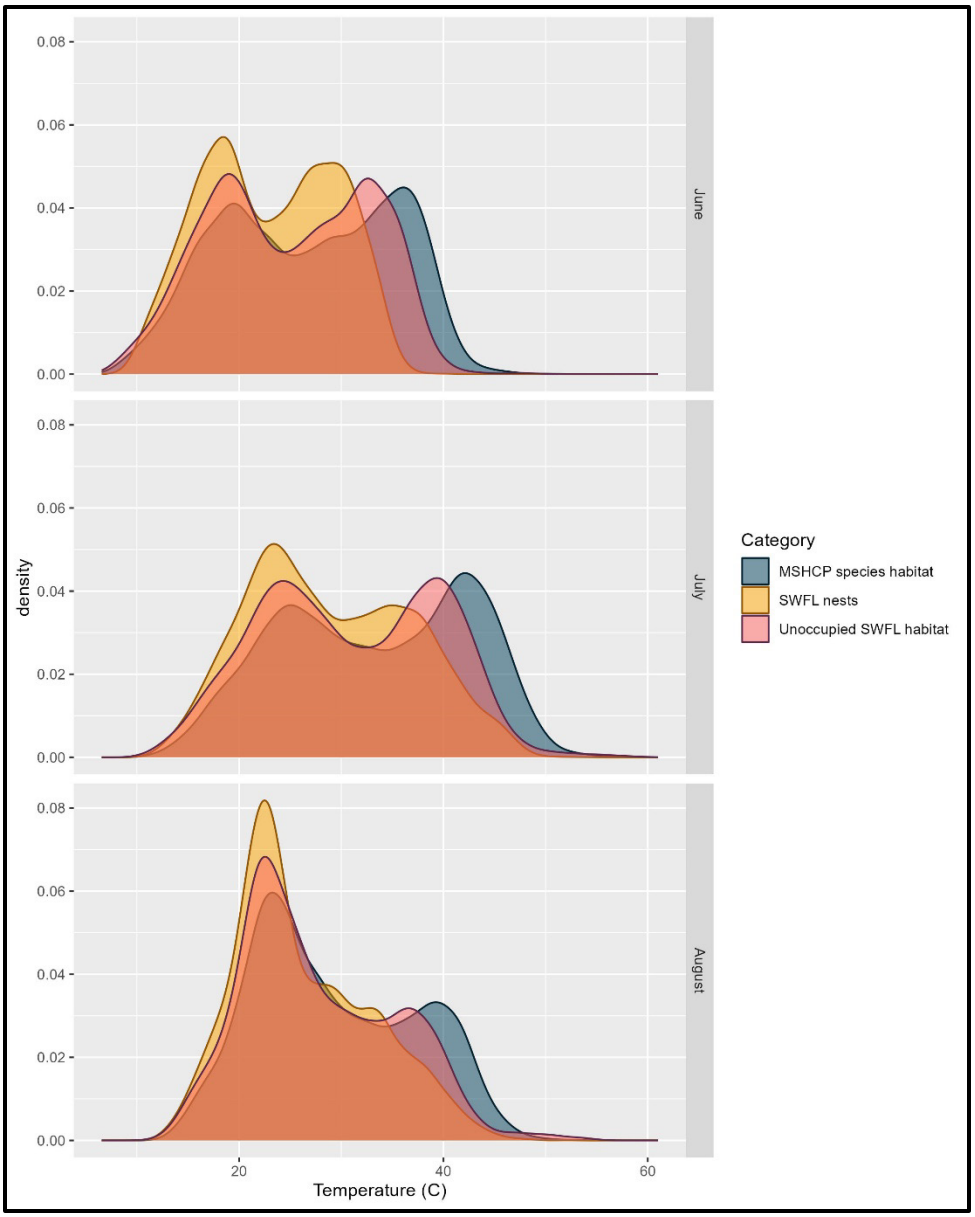

Figure 22. Density plot of temperature measurements by habitat category and month.

This pattern suggested the need to evaluate the daily maximum temperature in addition to the daily mean temperature in the statistical analysis, because the mean alone did not describe what was occurring at either extreme of the daily temperature range and may instead have represented the area between the peaks. For relative humidity, the density plots showed that the relative humidity measurements were substantially higher at the SWFL nests than at the other two habitat types (Figure 23). There was no clear bimodal distribution in relative humidity like that observed in temperature, which suggested that only mean daily humidity needed to be evaluated statistically.

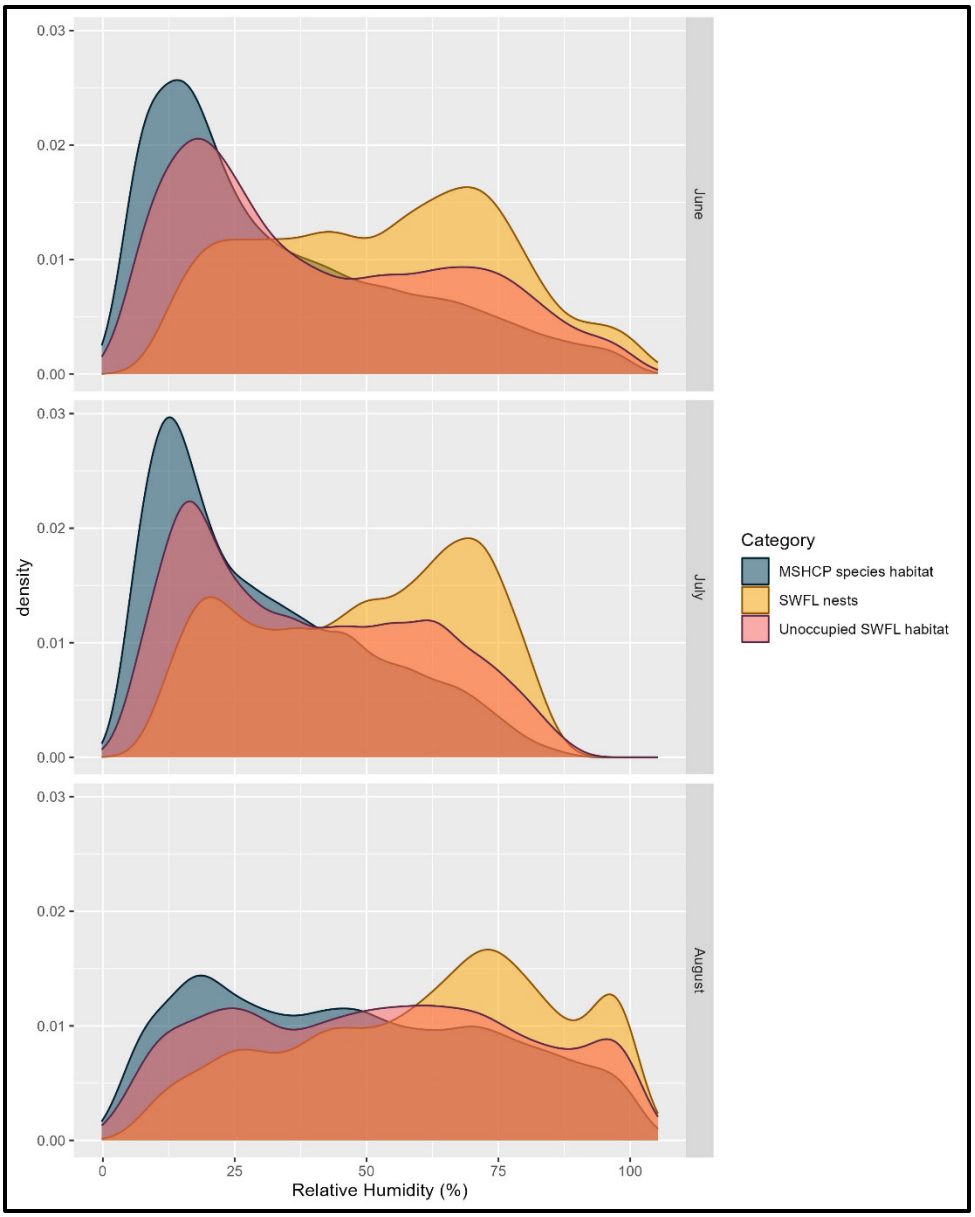

Figure 23. Density plot of relative humidity measurements by habitat category and month.

3.3.4.2.2 Statistical Evaluation

The three parameters we selected for statistical evaluation were daily maximum temperature, daily mean temperature, and daily mean relative humidity. Differences in these parameters between SWFL nests and MSHCP species habitat were estimated for the whole nesting season (June through August), and within each individual month (June, July, or August). The measurements for these parameters are summarized in Table 16.[1]

[1] The differences described in the statistical comparisons below may differ slightly from the values that could be calculated from this table. This is because the statistical comparisons control for autocorrelation (i.e., the individual readings at each datalogger are not independent of other readings at that datalogger), and the data summarized in the table do not.

Table 16. Summary of Temperature and Humidity Parameters by Month, 2023

Parameter	Category	Month	Mean	25th Percentile	50th Percentile (median)	75th Percentile
Daily maximum temperature (ºC)	MSHCP species habitat	June	39.02	37.04	39.07	41.07
		July	46.89	44.52	46.54	49.06
		August	41.93	39.17	42.56	45.06
	SWFL nests	June	32.31	30.60	32.17	34.17
		July	41.95	38.61	41.64	45.53
		August	37.91	34.11	38.10	41.88
	Unoccupied SWFL habitat	June	36.68	34.60	36.32	38.55
		July	44.70	41.59	44.07	46.56
		August	40.52	37.05	40.07	43.58
Daily mean temperature (ºC)	MSHCP species habitat	June	26.84	25.08	26.75	28.33
		July	33.37	31.16	33.51	35.76
		August	29.35	27.94	29.51	30.84
	SWFL nests	June	23.02	21.44	22.62	23.96
		July	29.03	27.05	29.30	31.12
		August	26.36	25.56	26.43	27.41
	Unoccupied SWFL habitat	June	25.07	23.02	24.74	26.44
		July	30.98	28.80	31.08	33.28
		August	27.85	26.75	28.04	29.12
Daily mean relative humidity (%)	MSHCP species habitat	June	33.22	22.41	30.64	41.82
		July	30.32	23.20	28.51	36.82
		August	47.13	35.06	45.33	57.43
	SWFL nests	June	52.99	46.13	51.94	60.64
		July	49.07	43.99	49.31	54.47
		August	61.96	52.29	60.01	68.87
	Unoccupied SWFL habitat	June	40.57	30.20	40.52	49.31
		July	38.56	31.06	37.92	45.65
		August	52.29	40.55	51.59	60.00

The daily maximum temperature at the SWFL nests was 4.1°C (7.4 ºF) lower on average than in the MSHCP species habitat during the 3-month nesting season (Table 17). While the difference in temperature between these habitats was highly significant in all months, it was greatest during June, when the daily maximum temperature at SWFL nests was 7.0°C (12.6 ºF) lower than in the MSHCP species habitat (Figure 24).

Table 17. Statistical Comparison of Daily Maximum Temperature between MSHCP Species Habitat and SWFL Nests for the Nesting Season and for Each Month, June through August 2023

Period	Difference in Maximum Daily Temperature (°C) between SWFL Nests and MSHCP Species Habitat	Standard Error	Significance Level (*P*)
June through August	−4.1020	1.1215	<0.001
June	−6.9724	1.6994	<0.001
July	−4.4643	1.2447	<0.001
August	−4.0302	1.0896	<0.001

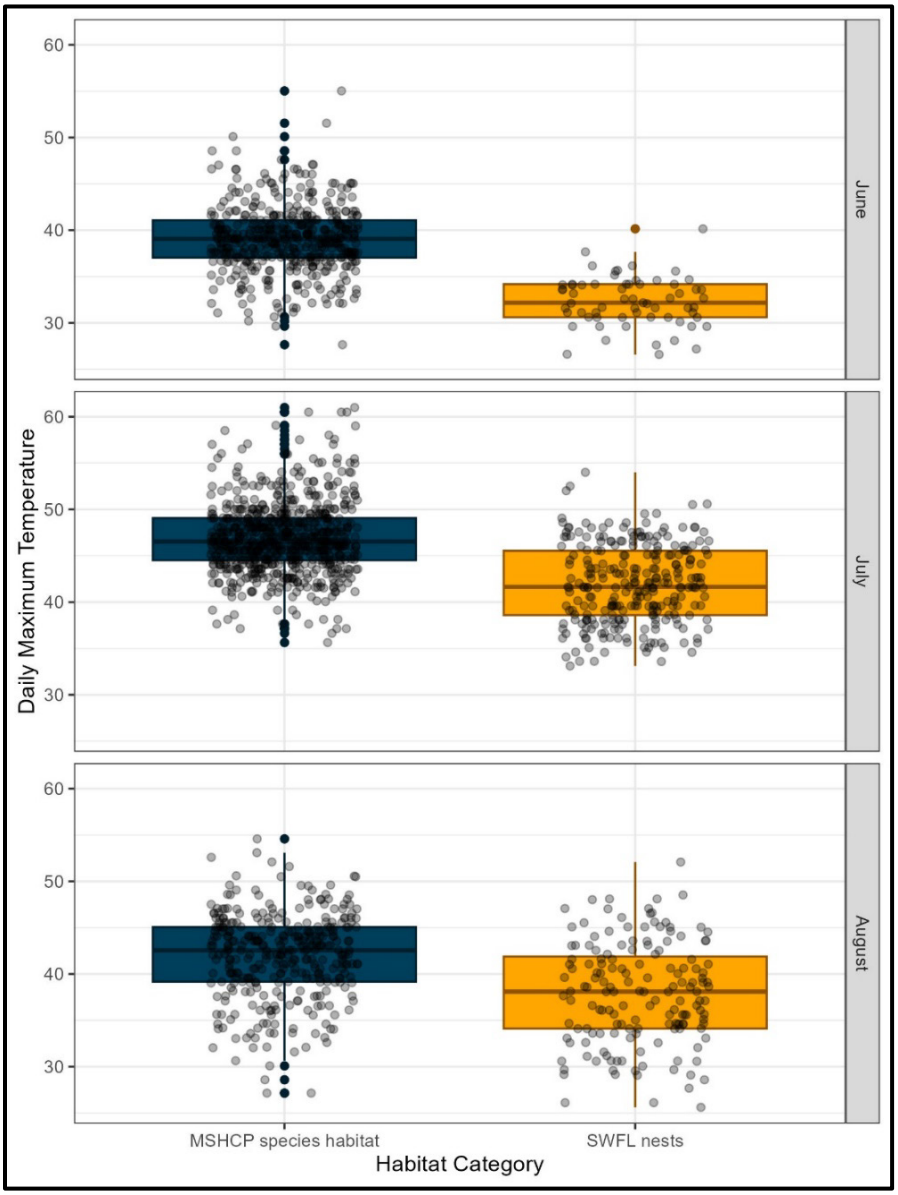

Figure 24. Comparison of daily maximum temperature at SWFL nests and in MSHCP species habitat, June through August 2023.

The daily mean temperature at the SWFL nests was 3.8°C (6.8 ºF) lower on average than in the MSHCP species habitat during the 3-month nesting season (Table 18). While the difference in temperature between these habitats was highly significant in all months, it was greatest during July, when the daily mean temperature at SWFL nests was 4.1°C (7.4ºF) lower than in the MSHCP species habitat (Figure 25).

Table 18. Statistical Comparison of Daily Mean Temperature Between MSHCP Species Habitat and SWFL Nests for the Nesting Season and for Each Month, June through August 2023

Period	Difference in Mean Daily Temperature (°C) between SWFL Nests and MSHCP Species Habitat	Standard Error	Significance Level (*P*)
June through August	−3.7633	0.4995	<0.001
June	−3.8745	0.7513	<0.001
July	−4.1115	0.6482	<0.001
August	−3.0102	0.4353	<0.001

The daily mean relative humidity at the SWFL nests was 16.1 percentage points greater on average than in the MSHCP species habitat during the 3-month nesting season (Table 19). While the difference in relative humidity between these habitats was highly significant in all months, it was greatest during June, when the daily mean relative humidity at SWFL nests was 19.9 percentage points greater than in the MSHCP species habitat (Figure 26). This finding was expected, as the temperature difference was the greatest in June and relative humidity is dependent on temperature.

Of these parameters, SWCA avian biologists selected daily maximum temperature and daily mean humidity in June and July to compare unoccupied SWFL habitat to SWFL nests, because these parameters exhibited the greatest differences between SWFL nests and MSHCP species habitat.

3.3.4.2.3 Comparative Evaluation of Unoccupied SWFL Habitat

The microclimate data collected from unoccupied SWFL habitat were compared to the IQR of the measurements collected from the SWFL nests and MSHCP species habitat through a series of boxplots. These comparisons were completed for daily maximum temperature in June (Figure 27) and July (Figure 28) and for daily mean relative humidity in June (Figure 29) and July (Figure 30). Each boxplot represents an individual datalogger, labeled with a four-character alphanumeric code indicating the serial number of the datalogger and, in parentheses, the parcel name (MWW refers to Mesquite West West).

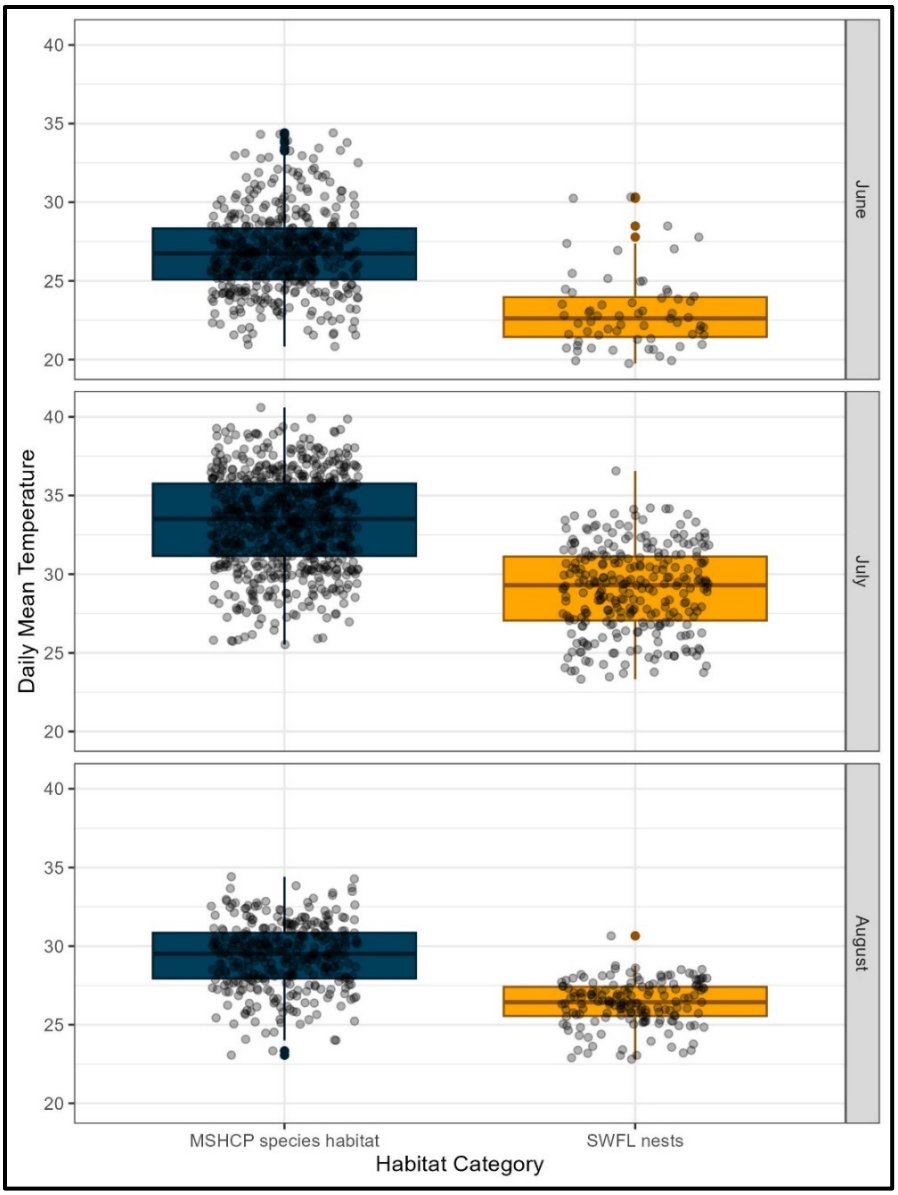

Figure 25. Comparison of daily mean temperature at SWFL nests and in MSHCP species habitat, June through August 2023.

Table 19. Statistical Comparison of Daily Mean Relative Humidity between MSHCP Species Habitat and SWFL Nests for the Nesting Season and for Each Month, June through August 2023

Period	Difference in Relative Humidity (%)* between SWFL Nests and MSCHP Species Habitat	Standard Error	Significance Level (*P*)
June through August	16.911	2.568	<0.001
June	19.926	4.126	<0.001
July	18.196	2.809	<0.001
August	14.897	2.502	<0.001

* expressed as percentage points, not percent change

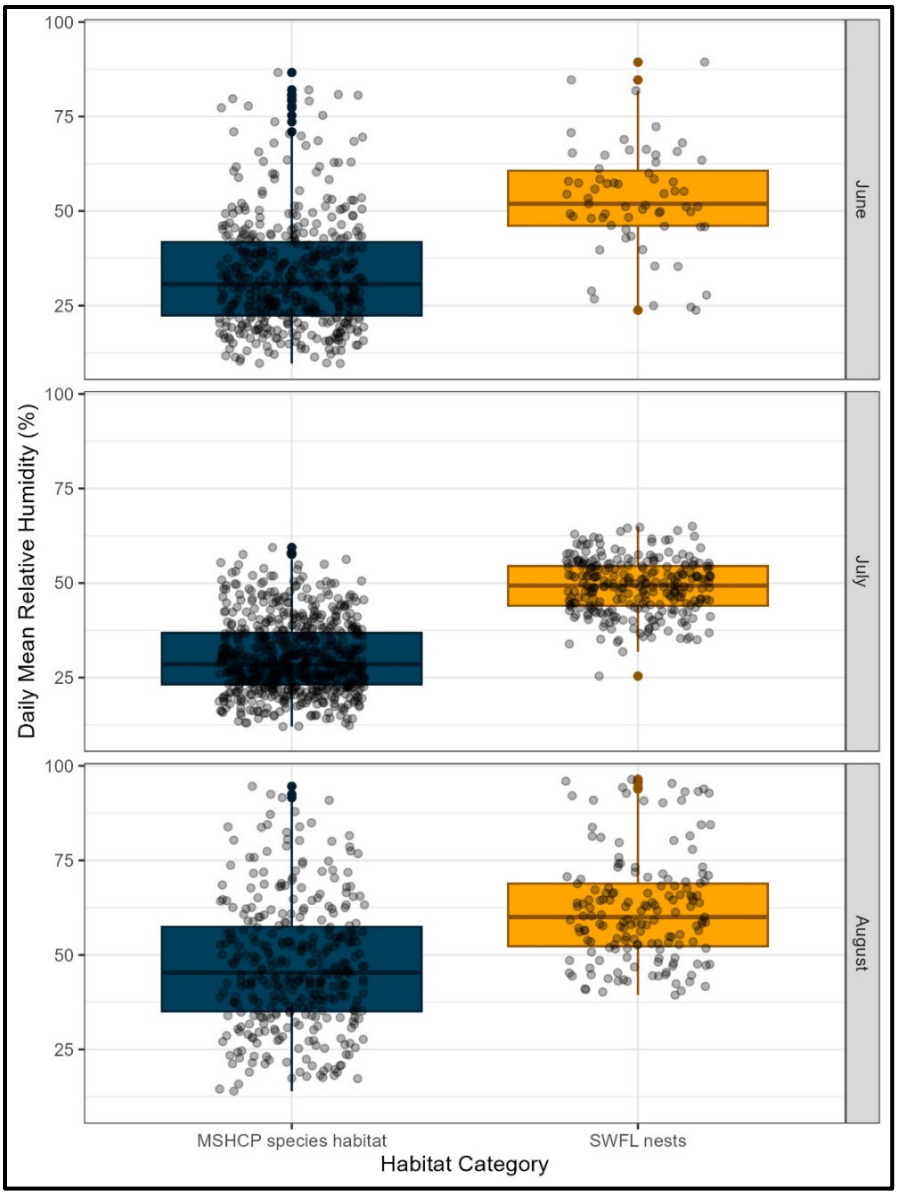

Figure 26. Comparison of daily mean relative humidity at SWFL nests and in MSHCP species habitat, June through August 2023.

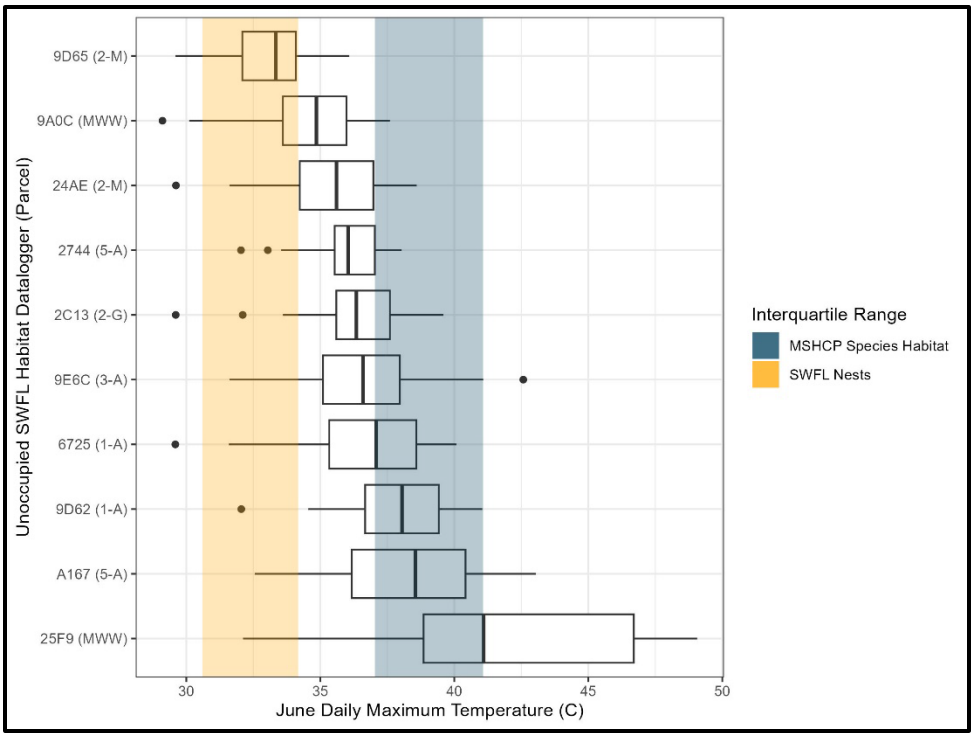

Figure 27. Daily maximum temperature at unoccupied SWFL habitat compared to the interquartile range (25th to 75th quartiles) of maximum temperatures at SWFL nests and in MSHCP species habitat, June 2023.

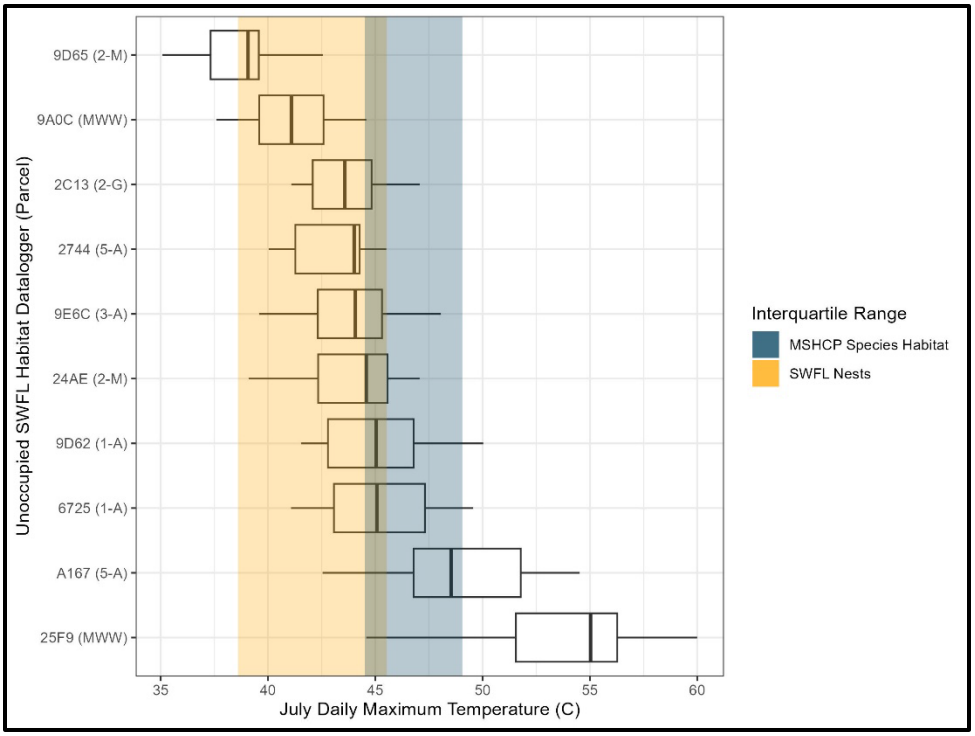

Figure 28. Daily maximum temperature at unoccupied SWFL habitat compared to the interquartile range (25th to 75th quartiles) of maximum temperatures at SWFL nests and in MSHCP species habitat, July 2023.

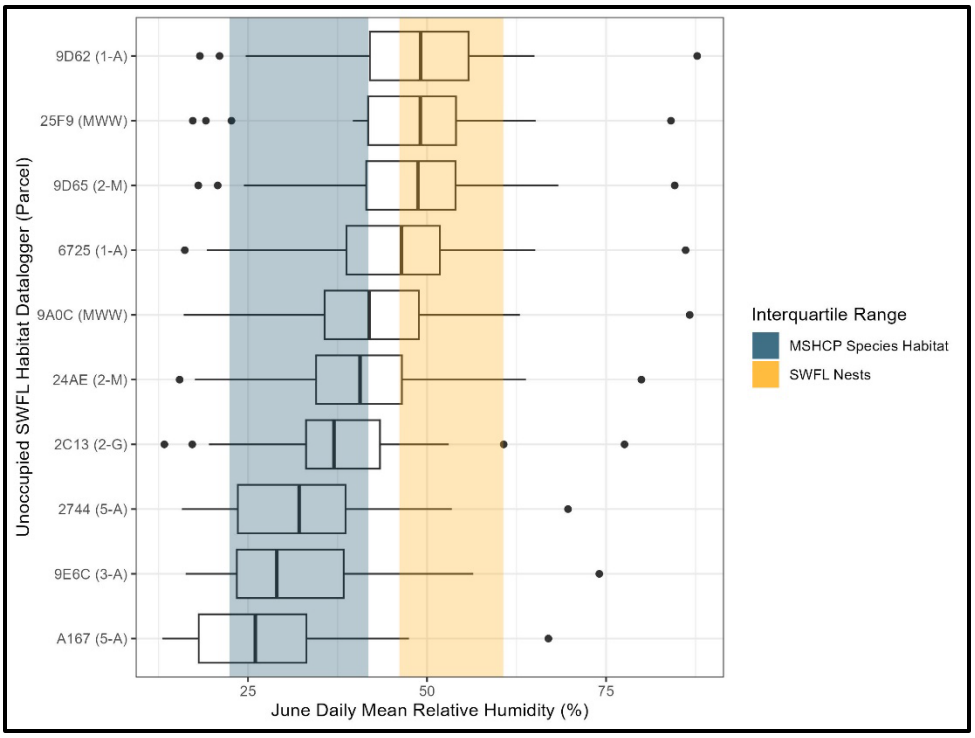

Figure 29. Daily mean relative humidity at unoccupied SWFL habitat compared to the interquartile range (25th to 75th quartiles) of mean relative humidity at SWFL nests and in MSHCP species habitat, June 2023.

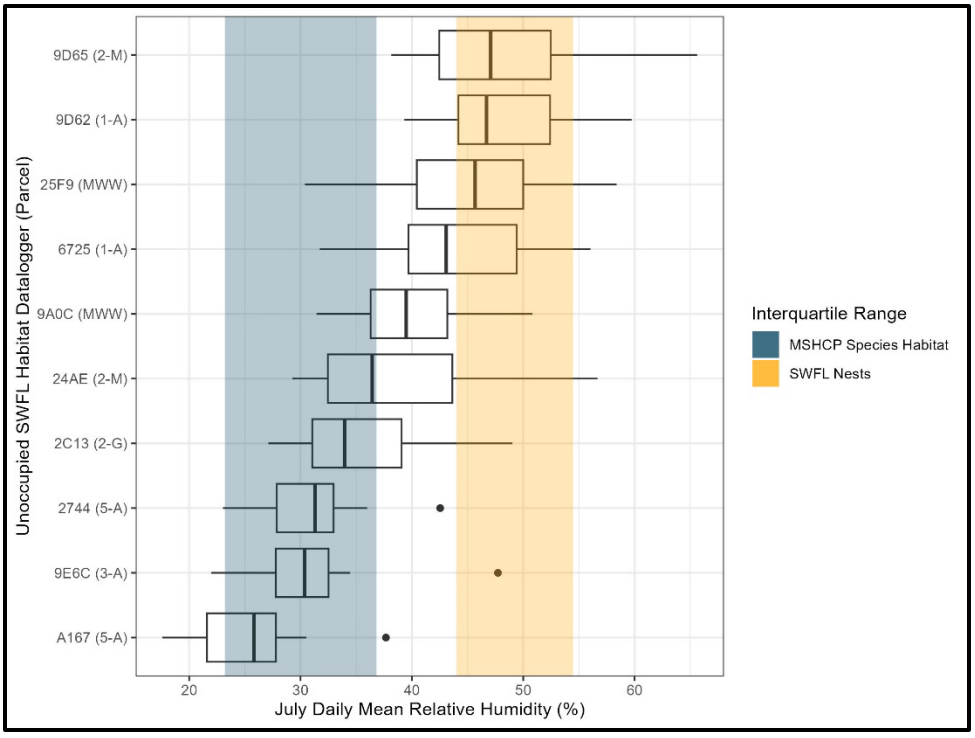

Figure 30. Daily mean relative humidity at unoccupied SWFL habitat compared to the interquartile range (25th to 75th quartiles) of mean relative humidity at SWFL nests and in MSHCP species habitat, July 2023.

Daily maximum temperatures in June at dataloggers 9D65 and 9A0C were most similar to those at SWFL nests, being the only two locations with an IQR (indicated by the white box in the boxplot) that overlapped the IQR of the SWFL nests (indicated by the gold-colored band in Figures 27–30). A greater number of dataloggers had maximum temperature conditions that overlapped those at SWFL nests in July; the IQRs overlapped at all dataloggers except A167 and 25F9. Daily mean relative humidity was most similar to that at SWFL nests at dataloggers 9D65, 9D62, 25F9, and 6725 in both June and July.

The similarities in microclimate between the unoccupied SWFL habitat and the SWFL nests were scored and ranked by normalizing the size of the difference between the median measurement at the SWFL nests and the median measure at the individual datalogger in unoccupied SWFL habitat (Table 20). The scores for each unoccupied SWFL habitat location were averaged and sorted from smallest (most similar) to largest (least similar). The ranks were applied to the unoccupied SWFL habitat locations in that order, indicating similarity to SWFL nests 1 (highest) to 10 (lowest) (Table 21). The unoccupied SWFL habitat locations with the greatest microclimate similarity to the SWFL nests were 9D65, 9A0C, and 9D62.

Table 20. Normalized Similarity Scores for Daily Maximum Temperature and Daily Mean Relative Humidity by Month

Unoccupied SWFL Habitat Datalogger	Month	Daily Maximum Temperature Difference (nest median − site median)	Daily Mean Relative Humidity Difference (nest median − site median)	Normalized Temperature Score	Normalized Humidity Score
24AE	June	−3.43	11.31	2.67	3.39
24AE	July	−2.94	12.88	2.28	3.86
25F9	June	−8.92	2.89	6.93	0.87
25F9	July	−13.39	3.64	10.40	1.09
2744	June	−3.86	19.82	3.00	5.94
2744	July	−2.38	18.01	1.85	5.40
2C13	June	−4.17	14.96	3.24	4.48
2C13	July	−1.94	15.35	1.51	4.60
6725	June	−4.91	5.51	3.81	1.65
6725	July	−3.43	6.24	2.66	1.87
9A0C	June	−2.68	10.03	2.08	3.01
9A0C	July	0.55	9.83	0.43	2.95
9D62	June	−5.87	2.83	4.56	0.85
9D62	July	−3.40	2.61	2.64	0.78
9D65	June	−1.16	3.22	0.90	0.97
9D65	July	2.57	2.24	2.00	0.67
9E6C	June	−4.42	22.92	3.44	6.87
9E6C	July	−2.43	18.93	1.89	5.68
A167	June	−6.37	25.93	4.95	7.77
A167	July	−6.89	23.49	5.35	7.04

Table 21. Mean of the Normalized Scores for Daily Maximum Temperature and Daily Mean Relative Humidity in June and July, Sorted and Ranked

Unoccupied SWFL Habitat Datalogger	Parcel	Average of Normalized Temperature Score	Average of Normalized Humidity Score	Average Score	Similarity Rank
9D65	2-M	1.45	0.82	1.13	1
9A0C	Mesquite West West	1.25	2.98	2.11	2
9D62	1-A	3.60	0.82	2.21	3
6725	1-A	3.24	1.76	2.50	4
24AE	2-M	2.47	3.63	3.05	5
2C13	2-G	2.38	4.54	3.46	6
2744	5-A	2.42	5.67	4.05	7
9E6C	3-A	2.66	6.27	4.47	8
25F9	Mesquite West West	8.67	0.98	4.82	9
A167	5-A	5.15	7.41	6.28	10

Note: The rank indicates similarity to SWFL nests 1 (highest) to 10 (lowest).

4 EVALUATION/DISCUSSION OF RESULTS

This project builds on a baseline avian dataset for the County's MSHCP properties. Point-count surveys across the Riparian Reserve Units resulted in a total of 69 avian species detected, including seven MSHCP-covered and evaluation species; three additional MSHCP-covered and evaluation species were incidentally detected in 2023. Point counts across the BCCE yielded 22 total avian species, including two MSHCP evaluation species. Goals identified in both the Riparian Reserve Unit Management Plan (Clark County 2015) and the BCCE Management Plan (Clark County 2023) include managing these properties to protect MSHCP-covered species. Baseline vegetation community and structure data for the MSHCP properties are necessary to inform habitat management interventions for managing avian species at these properties. This section includes a closer analysis of avian species presence and distribution for each set of connected parcels within the Riparian Reserve Units and at the BCCE, as well as a qualitative assessment of existing vegetation conditions therein.

4.1 Mesquite

4.1.1 Parcel 1-A

Most of the vegetation at Mesquite Parcel 1-A consists of narrowleaf willows (*Salix exigua*), most of which are 4 to 7 m (13.1–23.0 feet) in height (Figure 31); the remainder of the vegetation consists primarily of tamarisk 4 to 6 m (13.1–19.7 feet) in height and patches of narrowleaf willows approximately 3 to 4 m (9.8–13.1 feet) in height. In portions of Parcel 1-A that receive regular water flow, canopy closure generally ranges from 80% to 95%. Throughout the breeding season, water from Pulsipher Wash ran generally from north to south throughout most of Parcel 1-A; the wash can be seen entering Parcel 1-A from the north in Figure 3.

Figure 31. Typical narrowleaf willow habitat in areas with regular water flow at Mesquite Parcel 1-A showing dense cover and relatively closed canopy.

Hydrologic conditions within Parcel 1-A are highly variable from year to year, and at the start of the 2023 season, water flow entered Parcel 1-A from the north through the western of two manmade channels that flow into the site. Previously, water had flowed through the eastern channel, diverting west just north of the Parcel 1-A boundary. The flow of water through the western channel seemed to prohibit water from reaching as far south into the site as in previous seasons; therefore, areas in the southern third of the site that had previously been inundated or damp were dry in 2023 (Figure 32). In early August, repairs were made to the channel levee, which returned water flow to the eastern channel before splitting into both channels prior to entering the north end of Parcel 1-A; as a result, it appeared that more water flowed into the site and reached farther south than previously in the season. In the northern two-thirds of the site, soils remained damp to saturated on days when there were no flows entering the parcel via Pulsipher Wash. In the southern third of the site and along its eastern border, soils generally remained dry in 2023, and canopy closure was noticeably lower in 2023 than in previous years (see Figure 32).

It is believed that decreased canopy closure was likely a direct result of water stress, which caused trees to desiccate or die and leaves to wilt or fall off the trees. Decreased canopy closure allows more sunlight into and raises temperatures within riparian habitats. This can be detrimental during the nesting season, particularly for southwestern willow flycatcher, which chooses nesting areas that are cooler than the surrounding habitat (see Section 3.3.4.1); increases in temperature during the breeding season could cause nesting birds, including southwestern willow flycatcher, to desert nests. Despite reduced canopy closure from reduced water flow in 2023, this parcel contains the best habitat for southwestern willow flycatcher within the County's Riparian Reserve Units. All 4.0 ha (9.9 acres) originally delineated for surveys by the County were surveyed for federally listed birds in 2019 through 2023 (see Figure 3).

Figure 32. Typical narrowleaf willow habitat with reduced water flow at Mesquite Parcel 1-A showing browning and dying vegetation and cracked soil.

Habitat quality within Parcel 1-A is evidenced by the presence of multiple southwestern willow flycatcher territories (see Section 3.3.1 and Appendix A: Figure A-1). Parcel 1-A occupies most of the eastern portion of a larger study site known as Mesquite West, which has been monitored annually by SWCA (under various contracts) and NDOW biologists since 2003 (McLeod and Pellegrini 2013, 2014; NDOW, unpublished data). From 2003 through 2012, Mesquite West had anywhere from 6 to 30 resident adult southwestern willow flycatchers each year (McLeod and Pellegrini 2013).

As part of the thermal refugia study, two iButton dataloggers (9D62 and 6725) were placed within unoccupied SWFL habitat within Parcel 1-A in 2023 (see Figure 16). Datalogger 9D62 was deployed in an area that was unoccupied in 2023 but was occupied by an unpaired, territorial male for 13 days in 2022 (SWCA 2022). This area was not occupied in 2021 (SWCA 2021). The last time a pair occupied this general area was 2020, when a pair initiated two nesting attempts in an area just northeast of datalogger 9D62; however, neither of these two nesting attempts was successful (SWCA 2020). Datalogger 6725 was deployed in area that is near formerly occupied areas but which has not been occupied by southwestern willow flycatcher in the last 5 years. Despite the central and southern portions of Parcel 1-A being drier than in previous seasons, both dataloggers 9D62 and 6725 yielded mean relative humidity readings in June and July that were more similar to those collected at SWFL nests than those in MSHCP species habitat (see Figures 29 and 30). However, these two dataloggers also yielded daily maximum temperatures in June that were more similar to those recorded in MSHCP species habitat than those at SWFL nests (see Figure 27); July daily maximum temperatures at these two dataloggers fell directly between those recorded at SWFL nests and those recorded in MSHCP species habitat (see Figure 28). Higher daily maximum temperatures, particularly in June, could be precluding these areas from becoming occupied at a time when male southwestern willow flycatchers are starting to select territories and females are selecting nest sites. Still, perhaps unsurprisingly, of the 10 dataloggers deployed in

unoccupied SWFL habitat, dataloggers 9D62 and 6725 ranked third and fourth most similar to SWFL nests, respectively, when comparing daily maximum temperature and daily mean relative humidity (see Table 21). This suggests that some of the most suitable unoccupied SWFL habitat, relative to the County's other Riparian Reserve Unit parcels, lies within Parcel 1-A.

In addition to southwestern willow flycatcher, three other MSHCP-covered species were detected at Parcel 1-A in 2023: Arizona Bell's vireo, blue grosbeak, and yellow-billed cuckoo. Arizona Bell's vireo was detected at one of two point-count locations, and blue grosbeak was detected incidentally during southwestern willow flycatcher monitoring activities. Three yellow-billed cuckoo detections were recorded just west of the Parcel 1-A boundary in 2023. One detection occurred in response to vocalizations broadcast during a survey within Parcel 1-A; two additional detections occurred incidentally during southwestern willow flycatcher survey or monitoring activities at Mesquite West.

Though not an MSHCP-covered species, yellow warbler, a Mojave riparian indicator species (GBBO 2010), was also recorded singing multiple times within Mesquite Parcel 1-A in 2023, further indicating that Parcel 1-A has some of the best quality habitat of any of the parcels within the Riparian Reserve Units.

4.2 Bunkerville

The habitat at the Bunkerville Subunit is extremely varied, ranging from highly disturbed areas to mostly intact, native habitat. In vegetated areas, dominant species range from young, sparsely distributed arrowweed in sandy soil to mature monotypic tamarisk to dense stands of narrowleaf willow.
The following section describes the habitat and avian detections within each unique set of connected parcels in the Bunkerville subunit: 1) Parcels 2-A through 2-G and 2) Parcels 2-I through 2-M.

4.2.1 Parcels 2-A through 2-G

Bunkerville Parcels 2-A through 2-G contain mostly shrubby habitat with frequent openings that have been scoured by flooding or cleared by anthropogenic activities. Parcels 2-A through 2-E are mostly within the active floodplain of the Virgin River, which experiences frequent high-flow events. These parcels therefore consist largely of sandy bare ground dotted with sapling arrowweed and tamarisk (Figure 33). In 2019, higher than normal winter precipitation yielded significant spring runoff that scoured portions of these parcels, creating more open, unvegetated habitat. Of the 9.8 ha (24.3 acres) originally delineated for surveys by the County, 1.3 ha (3.2 acres) was scoured by the 2019 flooding, and 0.3 ha (0.7 acre) was burned in a wildfire late in 2017 (SWCA 2017a). This 1.6 ha (3.9 acres) of previously tamarisk-dominated woodland was excluded from surveys starting in 2019. In 2023, an additional 1.4 ha (3.4 acre) was excluded from surveys due to flooding during the winter of 2022 to 2023 that washed away a substantial portion of the survey area (Figure 34).

Parcels 2-A through 2-F do not currently contain vegetation that resembles typical southwestern willow flycatcher or yellow-billed cuckoo breeding habitat, and, through 2020, neither species was recorded within these parcels. In 2021, however, a yellow-billed cuckoo was recorded immediately south of Parcel 2-B in a patch of young narrowleaf willow. In 2022, one willow flycatcher detection was recorded in a sparsely vegetated patch of tamarisk in Parcel 2-D. In 2023, one yellow-billed cuckoo was detected during a survey approximately 225 m (783.2 feet) east-southeast of the northeast corner of Parcel 2-F; this yellow-billed cuckoo subsequently flew into willows in the northern portion of Parcel 2-F near the location where the surveyor played the survey broadcast. Vegetation in this area consists of a narrow strip of Goodding's willow (*Salix gooddingii*) and narrowleaf willow; this area is not suitable yellow-billed cuckoo breeding habitat due to this patch's very small size.

Figure 33. Examples of flood-disturbed habitat at Bunkerville Parcels 2-A through 2-E.

Figure 34. Evidence of flooding in 2023.

Parcels 2-A through 2-G lack the multistoried canopy that is generally used by yellow-billed cuckoo, and although the minimum canopy height for breeding southwestern willow flycatcher is considered to be 3 m (Sogge et al. 2010), occupied southwestern willow flycatcher sites along the Virgin River in 2003 through 2011 had median canopy heights of 5 to 6 m (16.4–19.7 feet) (McLeod and Pellegrini 2013). There is generally very little continuous canopy at this height within Parcels 2-A through 2-G. Median canopy closure of occupied southwestern willow flycatcher sites along the Virgin River from 2003 to 2011 was > 90% (McLeod and Pellegrini 2013). Portions of the site exhibit canopy closure that reaches 80%, but most of the site is much more open.

Bunkerville Parcels 2-F and 2-G are dominated by anthropogenically disturbed lands and include large areas that have been completely cleared of native vegetation (Figure 35). Any regrowth in this area is generally patchy tamarisk, arrowweed, and big saltbush (*Atriplex lentiformis*), 2 to 4 m (6.6–13.1 feet) in height, with little to no continuous canopy. A section of the southern portion of Bunkerville Parcel 2-F is currently being used for growing alfalfa (*Medicago sativa*) and grazing cattle (see Figure 4). The areas of Parcels 2-F and 2-G that have not been disturbed by anthropogenic activities are generally dominated by 1- to 3-m- (3.3- to 9.8-feet-) tall mule-fat (*Baccharis salicifolia*), tamarisk, screwbean mesquite, and intermittent arrowweed (Figure 36).

Figure 35. Anthropogenically disturbed habitat at Bunkerville Parcels 2-F and 2-G.

Figure 36. Examples of arrowweed and tamarisk habitat at Bunkerville Parcels 2-F and 2-G.

There are two small patches of narrowleaf willow at the north end of Parcel 2-F and in the northeast corner of Parcel 2-G. These patches consist largely of narrowleaf willow with intermittent mule-fat, screwbean mesquite, and tamarisk, all mostly between 3 and 4 m (9.8 and 13.1 feet) in height. A few mature Goodding's willows are also present in the Virgin River floodplain throughout Parcels 2-A through 2-G, including in these two patches. These areas of willow have intermittent surface water and relatively dense canopy cover (approximately 75%), but they are very small and are each less than 0.4 ha (1.0 acre) in size.

In 2023, SWCA placed one iButton datalogger (2C13) in the patch of narrowleaf willow in the northeast quadrant of Parcel 2-G (see Figure 18). Despite having relatively closed canopy cover, intermittent surface water, and dominant vegetation favored by southwestern willow flycatcher, this habitat was regularly hotter and less humid than conditions recorded at SWFL nests in 2023 (see Section 3.3.4). In fact, June maximum temperatures, June mean relative humidity, and July mean relative humidity at this datalogger were all more similar to conditions recorded in MSHCP species habitat than they were to conditions at SWFL nests (see Figures 27, 29, and 30, respectively). Only July maximum temperatures in this habitat were more similar to conditions at SWFL nests than they were to conditions in MSHCP species habitat (see Figure 28). While the habitat at 2C13 appears similar to breeding habitat for

southwestern willow flycatcher in several respects, it is possible that it is currently too hot and not humid enough to attract the species.

Four MSHCP-covered and evaluation avian species were recorded at Bunkerville Parcels 2-A through 2-G: American peregrine falcon, blue grosbeak, crissal thrasher, and vermilion flycatcher. Blue grosbeak was detected from all four point-count locations surveyed within this set of parcels in 2023, while American peregrine falcon and crissal thrasher were each detected at one of the four point-count locations. While blue grosbeak is considered a desert riparian obligate, the species is known to tolerate more open, scrubby habitat than can some of the other MSHCP riparian species (CCDCP and USFWS 2000). Crissal thrasher, an evaluation species, was recorded from one of the four point-locations within these parcels in 2023. This species prefers dense, scrubby vegetation often near water but is not a riparian obligate. Vermilion flycatcher was incidentally detected during a yellow-billed cuckoo survey.

4.2.2 Parcels 2-I and 2-J

Much of Bunkerville Parcels 2-I and 2-J appear to be subject to regular flooding, and some of the most abundant plants within these two parcels are sapling arrowweed and tamarisk less than 3 m (9.8 feet) tall (Figure 37). Additionally, much of the area is relatively unvegetated in comparison to other riparian habitat in the desert Southwest. This is likely due, at least in part, to regular flood events, including flooding in the spring of 2019 and again in the winter of 2022 to 2023. Of the 8.1 ha (20.1 acres) delineated for surveys by the County prior to 2019 surveys, 0.9 ha (2.2 acres) was scoured by spring flooding, leaving unvegetated bare ground. These areas were excluded from southwestern willow flycatcher and yellow-billed cuckoo surveys starting in 2019. In 2023, an additional 0.03 ha (0.01 acre) was excluded from surveys after flooding eliminated portions of previously surveyed habitat (Figure 38).

Bunkerville Parcels 2-I and 2-J host very few large native riparian trees, such as those used by southwestern willow flycatcher and yellow-billed cuckoo. Most of the mature riparian vegetation within these parcels consists of tamarisk and screwbean mesquite 2 to 5 m (6.6–16.4 feet) tall (Figure 39), and these stands have virtually no continuous canopy cover or nearby surface water. Additionally, much of the tamarisk is dead or dying, due to defoliation by tamarisk leaf beetles (*Diorhabda* spp.) or herbicidal treatment by the National Park Service (Deuser 2019, 2023). While tamarisk can provide habitat for desert riparian bird species, much of the tamarisk at Bunkerville Parcels 2-I and 2-J does not, due largely to its poor health at these two parcels. In 2022, a 1.8-ha (4.0-acre) polygon in the northwest corner of Parcel 2-I was excluded from southwestern willow flycatcher and yellow-billed cuckoo surveys due to tamarisk defoliation and lack of continuous canopy; this area was not surveyed in 2023.

Figure 37. Typical open, scrubby habitat at Bunkerville Parcels 2-I and 2-J.

Figure 38. Evidence of the 2023 flooding at Bunkerville Parcel 2-I.

Figure 39. Open tamarisk (left) and screwbean mesquite (right) habitat at Bunkerville Parcels 2-I and 2-J.

No southwestern willow flycatchers or yellow-billed cuckoos were detected during surveys at these parcels in 2023. Bunkerville Parcels 2-I and 2-J do not currently contain any potential breeding habitat for southwestern willow flycatcher or yellow-billed cuckoo. Despite a lack of native trees, Parcels 2-I and 2-J do have flowing channels, a pond, and a wet meadow/wetland with emergent vegetation (Figure 40), all of which could support native riparian habitat in the future. The wet meadow is in the east half of Parcel 2-J and is composed largely of sedges (Cyperaceae family) and wetland grasses, with scattered Goodding's willow and tamarisk. The wet meadow is unique within the County's reserve system and could be an area to target for riparian restoration. It appears the recent efforts to exclude cattle from this area are working, as no cattle or recent sign thereof were observed within the wet meadow habitat at Parcel 2-J in 2023. Pools of standing water were observed in the wet meadow at the beginning of the season, but the meadow was generally drier than in previous seasons.

One MSHCP-covered bird species (blue grosbeak) and one MSHCP evaluation bird species (crissal thrasher) were recorded within Bunkerville Parcels 2-I and 2-J during 2023 point-count surveys. Blue grosbeak was recorded at two of five point-count locations surveyed in 2023, and crissal thrasher was recorded at one of the five point-count locations.

Figure 40. Wet meadow habitat at Bunkerville Parcel 2-J.

4.2.3 Parcels 2-K through 2-M

Bunkerville Parcels 2-K, 2-L, and 2-M comprise a total of 23.9 ha (59.0 acres) and are immediately north of Bunkerville West Parcel 2-J (see Figure 4). In total, SWCA mapped 2.5 ha (6.3 acres) as potential yellow-billed cuckoo or southwestern willow flycatcher breeding habitat in Parcels 2-L and 2-M, which are characterized by isolated or narrow, or both, patches of riparian vegetation containing tamarisk, narrowleaf willow, and Goodding's willow adjacent to wet meadows, marshes, and open water features (Figure 41). American beaver (*Castor canadensis*) activity was noted adjacent to the pond in the southwest corner of Bunkerville Parcel 2-L in 2023 (see Figure 41); American beavers are known to greatly affect riparian habitat in the west, often contributing to the enhancement or maintenance of healthy, dynamic, and complex riparian ecosystems (Stromberg 1993).

Figure 41. Goodding's willow habitat at Bunkerville Parcel 2-M (left) and evidence of recent beaver activity at Parcel 2-L (right).

There were no areas mapped as potential yellow-billed cuckoo or southwestern willow flycatcher habitat within Parcel 2-K. Of the 2.5 ha (6.3 acres) delineated for surveys by the County prior to 2020 surveys, 0.4 ha (1.0 acres) was scoured by flooding in the winter of 2022 to 2023. These areas were excluded from southwestern willow flycatcher and yellow-billed cuckoo surveys in 2023 (Figure 42).

Figure 42. Evidence of 2023 flooding in Bunkerville Parcels 2-L and 2-M.

Outside the areas mapped as potential yellow-billed cuckoo and southwestern willow flycatcher habitat, mature vegetation consists of tamarisk and screwbean mesquite 2 to 5 m (6.6–16.4 feet) tall, and these stands have virtually no continuous canopy cover or nearby surface water. Other vegetation in Parcels 2-K through 2-M consists primarily of riparian scrub dominated by arrowweed, and soils in these areas were generally dry in 2023 (Figure 43). In 2023, marshes in the southern portion of Parcel 2-L were noted to be much drier than in 2022, and sapling tamarisk and cattails (*Typha* sp.) were filling in some of the previously marshy habitat (Figure 44). Bunkerville Parcel 2-L does not currently provide habitat for southwestern willow flycatcher; however, a small portion of habitat in the southeastern section of Bunkerville Parcel 2-M shows potential as suitable southwestern willow flycatcher nesting habitat, as evidenced by several factors: relatively dense Goodding's and narrowleaf willows, canopy closure > 80%, and intermittent inundation (see Figure 41).

Figure 43. Typical open, scrubby habitat at Bunkerville Parcels 2-L and 2-M.

Figure 44. Sapling tamarisk sprouting in a previously-inundated marsh in Parcel 2-L.

In 2023, two iButton dataloggers were placed in unoccupied SWFL habitat in Bunkerville Parcel 2-M: one datalogger (9D65) was placed in the potential southwestern willow flycatcher habitat at the southeast corner of Parcel 2-M (see Figure 18 and Figure 41 left photo), and one datalogger (24AE) was placed in the southwest corner of Parcel 2-M (see Figure 18), as this area contains mature tamarisk, a pond, and nearby narrowleaf willow, all habitat characteristics that may be associated with southwestern willow flycatcher nesting habitat. SWCA has considered both areas as prime candidates for restoration or enhancement given that they already meet several habitat requirements for southwestern willow flycatcher, particularly the southeast corner of Parcel 2-M. Results from the thermal refugia study seemingly corroborate the idea that habitat at both locations could become occupied by southwestern willow flycatcher in the future, as both dataloggers were relatively similar to SWFL nests in terms of maximum temperature and mean relative humidity when compared to other unoccupied SWFL habitat studied in 2023 (see Table 21). In fact, microclimate data recorded by datalogger 9D65 was the most similar unoccupied SWFL habitat datalogger to SWFL nests in 2023, with all June and July maximum temperature and mean relative humidity IQRs overlapping with the IQR for SWFL nests (see Figures 27–30), the only unoccupied SWFL habitat datalogger for which this can be said. Based on daily maximum temperature and mean relative humidity, it appears that the habitat in the southeastern corner of Parcel 2-M may already provide habitat suitable for nesting southwestern willow flycatcher and could become occupied in the future. Datalogger 24AE exhibited maximum daily temperatures in July that overlapped with the IQR recorded at SWFL nests, but June daily maximum temperatures and both June and July daily mean relative humidity did not (see Figures 27–30).

No southwestern willow flycatchers were detected during surveys at these parcels in 2023. One yellow-billed cuckoo was detected during surveys at the southeast corner of Parcel 2-M (see Appendix A: Figure A-5); vegetation at this location is relatively unique within these parcels and consists of a small (0.55-ha [1.35-acre]) area containing patches of 6- to 8-m- (19.7- to 26.2-feet-) tall Goodding's willow and 3- to 5-m- (9.8- to 16.4-feet-) tall narrowleaf willow. The area where the yellow-billed cuckoo was detected is the same area referenced above as potentially suitable southwestern willow flycatcher habitat. Though Parcels 2-L and 2-M are not currently occupied nesting habitat for southwestern willow flycatcher or yellow-billed cuckoo, the willow patch in the southeast portion of Parcel 2-M shows promise as southwestern willow flycatcher habitat. Future restoration actions, including changes in vegetation and water management, could improve the habitat potential for yellow-billed cuckoo and southwestern willow flycatcher in Parcels 2-K through 2-M.

No MSHCP-covered or evaluation bird species were recorded within Bunkerville Parcels 2-K through 2-M during 2023 point-count surveys.

4.3 Riverside

Much like Bunkerville Parcels 2-I and 2-J, Riverside Parcels 3-A and 3-B are composed mostly of the open, scrubby habitat typically found in riparian areas that experience frequent flooding (Figure 45). The Riverside Subunit was subjected to substantial seasonal runoff associated with above-average winter precipitation in the Virgin River watershed in 2019 and 2023. The 2019 flooding removed portions of a large, contiguous patch of tamarisk at the north end of the Riverside Subunit. Subsequently, of the 5.3 ha (13.1 acres) that the County originally identified for federally listed bird surveys, 3.9 ha (9.6 acres) was deemed suitable for surveys by SWCA. Flooding during the winter of 2022 to 2023, as well as construction of a humanmade channel near the western border of Riverside Parcel 3-A (Figure 46), removed an additional 0.3 ha (0.8 acre) of habitat from the survey area. The survey area consisted of two general vegetation types: 1) relatively contiguous tamarisk 3 to 4 m (9.8–13.1 feet) in height, with canopy closure < 50%, and 2) a strip, generally less than 5 m (16.4 feet) wide, of 3- to 4-m- (9.8- to 13.1-feet-) tall narrowleaf willow along an irrigation ditch (Figure 47).

Figure 45. Scrubby, open habitat within the floodplain at Riverside Parcels 3-A and 3-B.

Figure 46. Humanmade channel at Riverside Parcel 3-A.

Figure 47. Narrowleaf willow along the irrigation ditch at Riverside Parcels 3-A and 3-B.

Large areas of dense 2-m- (6.6-foot-) tall arrowweed and fairly dense 2- to 4-m- (6.6- to 13.1-foot-) tall screwbean and honey mesquite (*Prosopis glandulosa*) are present in the central portion of Parcel 3-A. Between the 2018 and 2019 surveys, most of the largest patch of mesquite was cut down by an unknown party (Figure 48). Regrowth of these mesquite trees in Parcel 3-A was observed from 2020 through 2023 (see Figure 48).

Figure 48. Mesquite patch at Riverside Parcels 3-A and 3-B in 2019 after cutting (left) and in 2023 after several years of regrowth (right).

Four MSHCP-covered avian species were recorded at the Riverside Subunit: Arizona Bell's vireo, blue grosbeak, phainopepla, and vermilion flycatcher. Arizona Bell's vireo was detected from all four of the point-count locations surveyed in 2023; phainopepla was detected at one of these four point-count locations. Blue grosbeak and vermilion flycatcher were detected incidentally during thermal refugia datalogger placement and yellow-billed cuckoo surveys, respectively. Arizona Bell's vireo is a desert riparian obligate. This species can also occupy dense mesquite habitat, and Arizona Bell's vireos were regularly heard singing and seen foraging in screwbean and honey mesquite at the Riverside Subunit. The MSHCP identifies blue grosbeak and phainopepla as capable of occupying habitat other than desert riparian, and blue grosbeak can occupy open riparian habitat (CCDCP and USFWS 2000). Phainopepla prefers shrub- or mesquite-dominated habitats and depends heavily on mistletoe (*Phoradendron* spp.) berries that grow on mesquite. Riverside Parcels 3-A and 3-B have a relatively abundant population of screwbean and honey mesquite compared to the other Riparian Reserve Units. Two MSHCP evaluation

species were recorded in 2023: crissal thrasher and loggerhead shrike. Crissal thrasher was detected from one of the four point-count locations surveyed in 2023, and loggerhead shrike was detected incidentally during yellow-billed cuckoo surveys.

The Riverside Subunit does not currently contain vegetation that resembles typical southwestern willow flycatcher or yellow-billed cuckoo breeding habitat. The patch of narrowleaf willows along the irrigation ditch is generally not wide enough to provide suitable breeding habitat, and the patches of tamarisk are dry and open and do not have the saturated soils typical of southwestern willow flycatcher breeding habitat. Surface water at the Riverside Subunit is restricted to the active river channel and the irrigation ditch along the east side of the Subunit. Furthermore, the Riverside Subunit completely lacks the mature vegetation and multistoried canopy that are generally required by yellow-billed cuckoo.

As part of the thermal refugia study, iButton datalogger 9E6C was placed in a dense linear patch of narrowleaf willow along the irrigation ditch in Parcel 3-A (see Figure 19). It was not believed that this habitat feature was big enough to provide nesting habitat for southwestern willow flycatcher because it is so narrow, but because regular surface water and tall, closed-canopy narrowleaf willow are present here, an unoccupied SWFL habitat datalogger was placed in this location to test this hypothesis. As expected, the habitat at this location did not regularly exhibit a microclimate similar to that recorded at SWFL nests (see Table 21), and only July maximum daily temperatures recorded by 9E6C overlapped with the IQR recorded at SWFL nests (see Figures 27–30).

4.4 Mormon Mesa

For several decades, Parcel 5-A in the Mormon Mesa Subunit has been largely dominated by monotypic tamarisk. However, much of this vegetation has died or is dying as the result of defoliation by tamarisk leaf beetles. In 2018, the County masticated 1.7 ha (4.3 acres) of dead tamarisk and, in 2020, masticated an additional 14.6 ha (36.0 acres). These areas of masticated tamarisk were not surveyed for southwestern willow flycatcher or yellow-billed cuckoo in 2023 (Figure 49, see Figure 6). Narrow patches of mostly dead and dying tamarisk remain outside the masticated area along the eastern and southern boundary of the Mormon Mesa Subunit, but these areas do not provide the vegetative or hydrologic conditions used by nesting southwestern willow flycatcher or yellow-billed cuckoo and were not surveyed.

Figure 49. Masticated tamarisk at Parcel 5-A within the Mormon Mesa Subunit in 2022 (left) and masticated tamarisk in front of existing tamarisk habitat in 2023 (right).

An approximately 5-ha (13-acre) patch of screwbean mesquite and arrowweed shrubland is present in the southwest corner of this Subunit (Figure 50), and some large Goodding's willows and small patches of narrowleaf willows are present in the northwest corner. Seven restoration plots are also scattered throughout the northwest corner of the Mormon Mesa Subunit; in 2014, the County cleared non-native tamarisk and planted native vegetation within these plots (Figure 51; see Appendix A: Figure A-3). SWCA biologists observed cattle within multiple restoration plots at the Mormon Mesa Subunit in 2021. Cattle activity increased in 2022 and 2023 as access to the restoration plots became easier, and cattle and associated browsing and trampling of the vegetation were routinely recorded in and around the restoration plots in 2023 (Figure 52).

Figure 50. Screwbean mesquite habitat in the southwestern portion of Mormon Mesa Parcel 5-A.

Figure 51. Sample habitat within restoration plots at the Mormon Mesa Subunit in 2019.

Figure 52. Signs of cattle presence within restoration plots at the Mormon Mesa Subunit in 2023.

Water levels were higher than average in mid-May due to flooding along the Virgin River, with approximately 45 centimeters (18 inches) of water inundating most of Parcel 5-A. Water levels slowly decreased throughout the season, and very little surface water was present in July.

Although a pair southwestern willow flycatchers successfully nested in one of the County's restoration plots at Parcel 5-A in 2020 (SWCA 2020), only unpaired males were detected at Parcel 5-A in 2021 and 2022. In 2023, one pair nested just north of the Parcel 5-A boundary (see Appendix A: Figure A-2). Despite the lack of nesting attempts in the restoration plot from 2021 through 2023, this habitat still appears suitable for southwestern willow flycatcher, as canopy height, canopy closure, and hydrologic conditions do not appear to have changed appreciably since 2020 (Figure 53). Because this restoration plot was not occupied by southwestern willow flycatcher in 2023, SWCA placed an iButton datalogger (2744) in this unoccupied SWFL habitat as part of the thermal refugia study (see Figure 17). The data recorded at this datalogger one ranked seventh in similarity to data recorded at SWFL nests (see Table 21). It is possible that this habitat has gotten hotter and less humid since the successful nesting attempt at this location in 2020, perhaps due to destruction of vegetation by cattle.

Figure 53. Goodding's and narrowleaf willow habitat in the southwestern willow flycatcher–occupied restoration plot in Mormon Mesa Parcel 5-A, 2020 (left) and the same restoration plot in 2023 (right).

While tamarisk can provide habitat for desert riparian species, the dead or dying tamarisk at the Mormon Mesa Subunit has less benefit to wildlife than does native vegetation or live tamarisk. This is corroborated by the fact that the Mormon Mesa Subunit yielded the lowest species richness of any of the subunits during the 2017, 2019, 2021, and 2023 point-count surveys (surveys were not conducted at Mormon Mesa in 2018) and the second lowest species richness in 2020 and 2022. The dying monotypic tamarisk stands at Mormon Mesa provide less concealment from predators and are relatively hot and dry compared to living vegetation. Reduced canopy cover results in decreased thermal protection for eggs and nestlings (McLeod 2019). McLeod and Pellegrini (2013) showed that occupied breeding habitat for southwestern willow flycatcher exhibited > 90% median canopy closure along the Virgin River between 2003 and 2011. However, despite much of the unit appearing to be in poor health, there are still patches of mature native vegetation that should be protected.

Four MSHCP-covered species were recorded at the Mormon Mesa Riparian Reserve Unit: Arizona Bell's vireo, southwestern willow flycatcher, summer tanager, and yellow-billed cuckoo. Yellow-billed cuckoo was detected from one of the three point-count locations surveyed in 2023, and five detections were recorded during yellow-billed cuckoo surveys. Additionally, another yellow-billed cuckoo was incidentally detected north of the Parcel 5-A boundary during southwestern willow flycatcher monitoring activities. Arizona Bell's vireo and summer tanager were detected incidentally during southwestern willow flycatcher surveys. One MSHCP evaluation bird species was incidentally recorded during southwestern willow flycatcher surveys: loggerhead shrike.

4.5 Mormon Mesa South

In late 2021, the County acquired two parcels, 6-A and 6-B, approximately 0.8 km (0.5 mile) south of Mormon Mesa Subunit Parcel 5-A. These parcels compose the Mormon Mesa South Subunit. SWCA mapped 14.3 ha (35.4 acres) of potential southwestern willow flycatcher and yellow-billed cuckoo habitat to be surveyed in 2022; this area was also surveyed in 2023. Much of the vegetation in the site is similar to that of Mormon Mesa Subunit Parcel 5-A: dead or dying tamarisk 3 to 4 m (9.8 to 13.1 feet) in height, with 8- to 12-m- (26.2- to 39.4-feet-) tall Goodding's willows scattered in low numbers throughout the parcels (Figure 54). A backwater slough, which appears to have been created by floods or American beaver activity, or both, is present along the eastern edge of the site (Figure 55). The southwestern willow flycatcher and yellow-billed cuckoo survey habitat adjoins this slough area, as this was deemed the best of the marginal habitat within this Subunit. Narrow patches of 3- to 4-m-tall narrowleaf willows, common reed (*Phragmites australis*), and cattail are present along the immediate edge of the slough (see Figure 55).

Figure 54. Dead and dying tamarisk within the Mormon Mesa South Subunit.

Figure 55. Backwater slough and adjacent cattail along the eastern boundary of the Mormon Mesa South Subunit.

The Mormon Mesa South Subunit exhibited the second-lowest species richness in 2023. Like the tamarisk at the Mormon Mesa Subunit, the dead or dying tamarisk at the Mormon Mesa South Subunit has less benefit to wildlife than does native vegetation or live tamarisk. The narrowleaf willows present along the edge of the slough stand approximately 2 to 3 m in height and provide canopy closure of less than 50%. The height and density of these small areas of narrowleaf willow habitat are not suitable for southwestern willow flycatcher or yellow-billed cuckoo.

Two MSHCP-covered species were recorded at the Mormon Mesa South Riparian Reserve Unit: Arizona Bell's vireo and blue grosbeak. Both species were recorded from one of the two point-count locations surveyed in 2023. One evaluation bird species was recorded from one of the two point-count locations: crissal thrasher.

4.6 Muddy River

Vegetation at the Muddy River Riparian Reserve Unit is highly diverse. Parcels A–E are dominated by horticultural plantings (e.g., pine [*Pinus* spp.] and California fan palm [*Washingtonia filifera*]) (Figure 56), creosote bush (*Larrea tridentata*) scrubland, and big saltbush (Figure 57). Parcel F is dominated almost completely by creosote bush scrub, with smaller patches of honey mesquite, particularly in the central and southeastern portions of the parcel (Figure 58). Parcels G–I are composed largely of very dense thickets of big saltbush and Mojave seablite (*Suaeda moquinii*) mixed with scattered honey mesquite and tamarisk (Figure 59). Although the Muddy River runs near the Muddy River Riparian Reserve Unit, it does not run through any of the southern parcels and only forms the eastern boundary of Parcels A–E. This portion of the Muddy River is also deeply incised, and desert riparian vegetation, consisting of widely scattered tamarisk and velvet ash (*Fraxinus velutina*), is generally limited to within approximately 2 m (approximately 6 feet) of the riverbank.

Figure 56. Horticultural trees planted at Muddy River Parcels A–E.

Figure 57. Big saltbush-dominated areas at Muddy River Parcels A–E.

Figure 58. Creosote bush and honey mesquite habitat at Muddy River Parcel F.

Figure 59. Varied scrub habitat at Muddy River Parcels G–I.

Five MSHCP-covered bird species were recorded at the Muddy River Riparian Reserve Unit in 2023: American peregrine falcon, Arizona Bell's vireo, blue grosbeak, phainopepla and yellow-billed cuckoo. Blue grosbeak and phainopepla were each detected from two of the seven point-count locations surveyed in 2023, and American peregrine falcon and Arizona Bell's vireo were each detected from one of the seven point-count locations. Yellow-billed cuckoo was detected during species-specific surveys. One MSHCP evaluation bird species was recorded from five of the seven point-count locations surveyed during in 2023: crissal thrasher. This species is typically found in dense cover within mesquite and riparian woodlands (Floyd et al. 2007). One crissal thrasher nest was found in Parcels A–E by biologists hanging dataloggers for the thermal refugia study. Most of the desert riparian obligates (e.g., southwestern willow flycatcher and yellow warbler) were not detected in the Muddy River Riparian Reserve Unit in 2023, which is not surprising given the lack of native desert riparian habitat at this property.

4.7 BCCE

Mojave Desert scrub, which is co-dominated by creosote bush and burrobush (*Ambrosia dumosa*), is the dominant vegetation community across the Mojave Desert, and this community covers over 97% of the BCCE (Clark County 2023). Most point-count survey locations at the BCCE are within this habitat type (Figure 60). The remainder of the BCCE is composed of salt desert scrub (1.5%), mesquite/acacia habitat (less than 1%), and previously disturbed habitat (Clark County 2023). A few survey points were in areas of dense cholla (*Cylindropuntia* spp.) or desert wash habitat (Figure 61).

The BCCE Management Plan identified that no MSHCP-covered avian species are known to occur within the BCCE (Clark County 2023). During the initial site reconnaissance and point-count surveys of the BCCE in 2018, biologists did not observe any habitat, including desert riparian habitat, that could be considered suitable breeding habitat for the MSHCP-covered avian species. No MSHCP-covered species were detected during point counts at the BCCE in 2023, though single phainopepla were recorded at two of the point-count locations in 2019 and 2022. Two evaluation species, LeConte's thrasher and loggerhead shrike, are known to occur within the BCCE (Clark County 2023) and were each recorded once within the BCCE during point-count surveys in 2023 (see Table 13). These two species have been recorded at the BCCE every year since 2018.

Figure 60. Mojave Desert scrub habitat at point-count locations 12 (left) and 17 (right).

Figure 61. Dense cholla at point-count location 33 (left) and desert wash habitat at point-count location 37 (right).

4.8 Brown-headed Cowbird Control and Southwestern Willow Flycatcher Nest Success

Following continued high brood parasitism rates and 100% failure of southwestern willow flycatcher nests at Mesquite West in 2020, SWCA implemented a target-netting program for brown-headed cowbirds at Mesquite West in 2021; this program continued through 2023. The goal of this program was to reduce the incidence of brood parasitism on southwestern willow flycatcher nests and improve nest success of southwestern willow flycatcher. SWCA was successful in target netting brown-headed cowbirds in 2023 and removed four female brown-headed cowbirds (Table 22). In addition, one brown-headed cowbird egg was replaced with a fake egg at a nest at Mesquite West West in 2023 (see Table 22). This nest was incubated for at least 9 days following the introduction of the fake brown-headed cowbird egg but ultimately failed.

Table 22. Brown-headed Cowbird Control by Method Used, Brown-headed Cowbird Parasitism, and Southwestern Willow Flycatcher Productivity, 2019–2023

Year	Parasitism Rate (%)	Brown-headed Cowbird Control Method[a]				Nest Success (%)
		Target Netting (No. Females Removed)	Egg Addling (No. CE[b] Addled)	Egg Replacement (No. CE[b] replaced with fake egg)	Nestling Removal (No. CN[c] Removed)	
2019	50	–	–	–	–	44
2020	40	–	1	–	0	0
2021	50	14	3	–	0	33
2022	22	11	1	1	1	78
2023	8	4	0	1	0	46

[a] A dash within a specific brown-headed cowbird control method indicates that SWCA was not permitted to conduct that method in that year, and, therefore, the method was not practiced.

[b] CE = brown-headed cowbird egg.

[c] CN = brown-headed cowbird nestling.

Prior to the implementation of brown-headed cowbird target netting in 2021, the parasitism rate of southwestern willow flycatcher nests at Mesquite West was 50% in 2019 and 40% in 2020 (see Table 22). Forty-four percent of southwestern willow flycatcher nests were successful in 2019; nest success dropped to 0 in 2020. In 2021, despite the implementation of a more intensive brown-headed control program, 50% of southwestern willow flycatcher nests at Mesquite West were parasitized. This parasitism rate seemed to indicate that brown-headed cowbird control efforts were initially unsuccessful in reducing parasitism rates.

During the first year of brown-headed cowbird netting in 2021, flycatcher nest success was 33%; two successful nests produced a total of three southwestern willow flycatcher fledglings. In 2022, only 22% of southwestern willow flycatcher nests were parasitized, and nest success was 78%; seven successful nests produced a total of 13 fledglings. The number of successful nests (seven) in 2022 was higher than in the previous three years combined (see Table 6). In 2023, the intensive brown-headed cowbird control program continued, and the recorded parasitism rate reached an all-time low for the site: 8% (see Table 22). Though the nest success rate decreased to 46% in 2023, the number of successful nests (six) was similar to that of 2022, a dichotomy explained by more nesting attempts in 2023 than in 2022.

Brown-headed cowbird control seems to have been successful in lowering the rate at which southwestern willow flycatcher nests were parasitized. However, the effects of reduced parasitism on nest success are less clear. While the percentage of successful southwestern willow flycatcher nests increased dramatically in 2022, this level of success was not replicated in 2023.

5 CONCLUSION

Eight MSHCP-covered and three MSHCP evaluation bird species were recorded at the County's reserve system properties in 2023. Intensive southwestern willow flycatcher monitoring and brown-headed cowbird control were also continued in 2023, and a thermal refugia study was newly added in 2023. Some notable conclusions about this year's efforts and the habitats at the County's properties are listed below.

- Southwestern willow flycatcher monitoring resulted in documentation of eight pairs at Mesquite West in 2023, seven of which were confirmed to be nesting. These seven nesting pairs had 13 nesting attempts, six of which were successful and produced 11 fledglings.

- SWCA successfully target netted 10 adult brown-headed cowbirds (four female, six male) at Mesquite West in 2023; the female brown-headed cowbirds were subsequently euthanized.
- One brown-headed cowbird egg was replaced with a fake egg at Mesquite West. This nest was incubated for at least 9 days after the introduction of the fake egg but ultimately failed.
- Increased brown-headed cowbird control began in 2021 and coincided with a parasitism rate of 50% in southwestern willow flycatcher nests at Mesquite West. Increased brown-headed cowbird control continued in 2022 and 2023, and the parasitism rates were 22% and 8%, respectively. Not only is this rate of parasitism observed in 2023 lower than the rates observed prior to increased brown-headed cowbird control in 2019 (50%) and 2020 (40%), it is also the lowest parasitism rate ever recorded by SWCA at the study site. The results from 2022 and 2023 suggest that increased brown-headed cowbird control may play a role in reducing the parasitism rates at Mesquite West.
- Seven flycatcher nests failed at Mesquite West in 2023. Depredation was the cause of failure for five (71%) of these nests. Other than cowbirds, many animals are known to depredate bird nests, including several avian species, snakes, raccoons, and small rodents. The species of nest predators that depredated flycatcher nests at Mesquite West in 2023 are unknown.
- Southwestern willow flycatcher monitoring at Mormon Mesa resulted in documentation of one pair and one nesting attempt in 2023. This nest failed, and the pair did not attempt to renest.
- A total of 17 yellow-billed cuckoo detections were recorded at the Riparian Reserve Units in 2023: 13 detections occurred during yellow-billed cuckoo surveys, and four were incidentally recorded. Yellow-billed cuckoo detections were recorded for the first time since surveys began in 2017 at Bunkerville Parcels 2-A through 2-G, Bunkerville Parcels 2-K through 2-M, and Riverside 3-A and 3-B.
- It appears that cattle have been successfully excluded from portions of Bunkerville Parcels 2-J and 2-M. The early stages of a positive vegetative response that were observed in 2021 were again observed in 2023, showing that cattle exclusion can have a positive effect on habitat maintenance, enhancement, and restoration.
- The two dataloggers deployed in unoccupied SWFL habitat in Bunkerville Parcel 2-M yielded microclimate data relatively similar to that recorded at SWFL nests. However, for these two locations specifically and for all of the unoccupied SWFL habitat, temperature and relative humidity are just two of a number of factors that likely influence site occupancy by southwestern willow flycatcher. Still, with enhancement or expansion of habitat, it's possible that these areas in Parcel 2-M could become occupied by southwestern willow flycatcher in the future.
- Breeding habitat for the MSHCP-covered bird species is currently limited or non-existent within the BCCE. Habitat for phainopepla could be created or enhanced with the establishment of more mesquite/acacia habitat, as long as that habitat also includes mistletoe, a required food source for phainopepla. One phainopepla was recorded at the BCCE during both the 2019 and 2022 point counts.
- Biologists recorded two MSHCP evaluation species at the BCCE in 2023: LeConte's thrasher and loggerhead shrike. Although breeding of LeConte's thrasher could not be confirmed within the BCCE during recent point-count surveys, this species is known to breed at the BCCE as several active nests were incidentally recorded in 2019 and 2020.

Aggressive efforts are likely required to restore, create, and enhance additional habitat for most of the MSHCP avian species at the County's Riparian Reserve Units. Continued monitoring of avian populations before, during, and after the restoration process is needed to document restoration success

within the County's properties. Recommendations to achieve these objectives are detailed in the following section.

6 RECOMMENDATIONS

The following recommendations are based on observations from the 2023 avian surveys and factors discussed in this report. These actions would support the County's long-term goals for the Riparian Reserve Units and the BCCE in Clark County:

- As directed by the *Clark County Desert Conservation Program Riparian Reserve Units Management Plan* (Clark County 2015), the County should continue to purchase parcels along the Virgin and Muddy Rivers, particularly available parcels adjacent to the existing Riparian Reserve Units (if possible), and attempt to purchase parcels along the Meadow Valley Wash.
- Tamarisk that has been killed or has suffered substantial dieback from tamarisk leaf beetles provides little benefit to avian species that require at least some degree of canopy closure for nesting. The County should begin or continue the removal of tamarisk from all its Riparian Reserve Units, particularly these dead or dying stands, provided that tamarisk removal is immediately followed by planting of native vegetation, such as willow and Fremont cottonwood (*Populus fremontii*), in suitable areas (SWCA 2017c).
- Native species plantings should be considered and are encouraged around existing native habitats. To protect native plants, any plantings should be protected with the installation of cattle exclusion fencing, particularly willows.
- Cattle have been observed at all the Riparian Reserve Subunits except Muddy River; they should be inhibited from foraging on native plantings, wherever practicable. Cattle exclusion fencing should be erected in any area where native trees are newly planted or planned for planting, such as potential new areas of fencing at Bunkerville Parcel 2-M. At parcels where fencing already exists, such as portions of Mormon Mesa and Bunkerville Parcel 2-J and 2-M, the County should make sure that all fences and gates are maintained and in proper working order. At Mormon Mesa, cattle have bypassed incomplete or ineffective fencing; maintenance of existing fencing and erection of additional perimeter fencing could prevent future breaches into the parcel.
- The County could plant honey and screwbean mesquite in areas of increased soil saturation that do not have the hydrological potential to support wetland facultative species like willow or cottonwood. Portions of the Riparian Reserve Units are susceptible to scouring floods, as evidenced by conditions recorded in 2019 and 2023. Any restoration plan should take this into account by limiting plantings in flood-prone areas or taking steps to protect planted areas from floods. The potential to create mature habitats at these sites may be limited by the flood risk.
- Because the Virgin River Riparian Reserve Unit is within designated critical habitat for the southwestern willow flycatcher, restoration plans should be designed in coordination with the USFWS.
- Avian point counts and species-specific surveys should be continued to help build on baseline data and to track changes in avian populations throughout the land management, restoration, and post-implementation processes. These surveys should use the protocols established for this project to ensure datasets are standardized and comparable.
- Additional target netting concentrated during the early part of the southwestern willow flycatcher breeding season may increase the number of female brown-headed cowbirds removed from the site prior to the onset of the southwestern willow flycatcher nesting period and may result in higher southwestern willow flycatcher productivity and fecundity.

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APPENDIX A

Location Maps for Federally Listed Birds

Confidential